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STRIGULA LATERALIS SPEC. NOV. WITH NOTES ON THE GENUS JULELLA (ASCOMYCETES)

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ABSTRACT: The new species *Strigula lateralis* is described from Portugal and Ireland, and compared with species of *Julella*. Notes are given on other species described in *Julella* or *Polyblastiopsis*.

Species of the non-lichenized ascomycete genus *Julella* Fabre have in the past attracted little attention. Although none of the known species is lichenized, they have been studied by lichenologists as much as by mycologists (Barr 1986, Harris 1973).

Most species of the genus have been described originally in *Polyblastiopsis,* and many have not been restudied recently. It is a predominantly tropical group of bark saprophytes. Up to now about 100 species names have been published in *Julella, Catharinia, Peltosphaeria* and *Polyblastiopsis*. An examination of some readily available material, however, suggests that only few species exist, most of which appear to be widely distributed. A key to these species is presented below.

Many records cited below are new records for the respective countries or even continents. Only one identified species of *Julella* has so far been reported from Portugal (Tavares, 1945, as *Polyblastiopsis fallaciosa*). In addition, an unknown species has been reported twice (Tavares 1942, van den Boom 1990). This species, for which no existing name could be found, is described below. It has also been found in Ireland and Australia. Although it strongly resembles *Julella*, it is described here in *Strigula* Fries because of the ascospore shape and the conidia which are referable to *Discosiëlla* Sydow & P. Sydow (Nag Raj 1993), the anamorph of the genus *Strigula*.

For the species concept in the group, an important observation is that ascospore dimensions tend to be more variable in ascomycetes with large, muriform spores than in species with smaller, non-muriform spores. This phenomenon can be observed in many different groups e.g., *Graphina*, Thelotremataceae, Pyrenulaceae and Trypetheliaceae. Accordingly, in *Julella* considerable variation has to be accepted within the species. The species recognized here are characterized by at least two correlated characters. Exceptions are *J. lactea* and *J. vitrispora*, which differ only in the number of ascospores per ascus. It remains to be seen whether these entities are really worth recognition at species level.

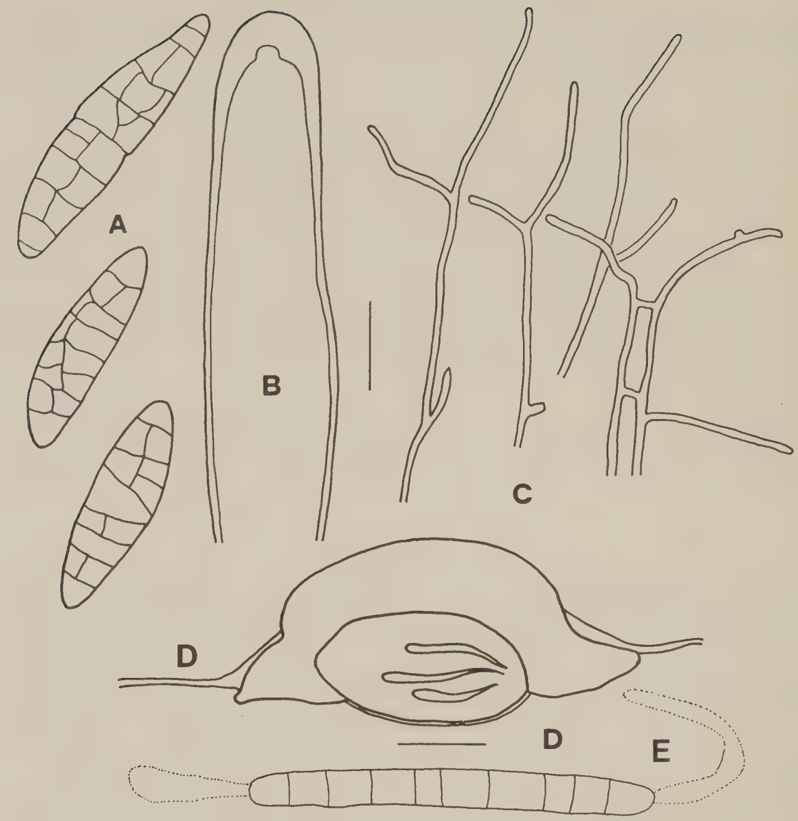

Fig. 1. *Strigula lateralis*: A ascospores; B ascus; C hamathecium filaments; D section through ascocarp; E conidium. A-D from the type, E from Coppins 15728. Bar = 10 μm in A, B, C & E; bar = 100 μm in D.

Key to the corticolous species of *Julella*

1a ascospores 2(-6)/ascus; ascocarps over 0.5 mm . . . . *J. lactea*
1b ascospores 8/ascus 2

2a ascospores over 21 μm long, usually over two times as long as wide; ascocarps over 0.5 mm . . . . *J. vitrispora*
2b ascospores under 21 μm long, usually less than two times as long as wide; ascocarps up to 0.5 mm . . . . *J. sericea*

1. **STRIGULA LATERALIS** Aptroot & v. d. Boom spec. nov. Fig. 1

Strigula species insignis ostiolis lateralibus et ascosporis muriformibus.

Type. PORTUGAL: Estremadura, Sintra, near Convento dos Capuchos, on *Castanea sativa* in wood, alt. 450 m, 9 VIII 1987, v. d. Boom 6489 (B, holotype; hb. v. d. Boom, hb. Aptroot, isotypes).

Thallus continuous, smooth, dull, non-corticate, ochraceous grey, up to 5 cm diam., surrounded by a black hypothallus. Algae sparsely present, belonging to *Trentepohlia*. Ascocarps perithecioid, rounded to irregularly ovoid, dull, black, 0.3-0.5 mm in diam., laterally partly covered by the thallus; wall consisting of a dimidiate clypeus, carbonized, 60-90 μm thick; ostiole lateral, almost indistinct; hamathecium clear, consisting of richly branching but sparingly anastomosing paraphysoids, up to 1 μm wide; asci cylindrical, originating at the wall opposite the ostiole, at apex thickened and with rounded ocular chamber; ascospores 8/ascus, fusiform-ellipsoid, hyaline, muriform, c. 7-9 x 0-2-septate, 25-35 x 6.5-8.5 μm, sometimes constricted at the median septum, with rather pointed ends, without ornamentation or gelatinous sheath. Pycnidia rounded, black, c. 0.1 mm diam; conidia not seen in the type, but present in the additional record from Ireland, hyaline, bacillar with rounded ends, 7-9(-10)-septate, 28-40 x 3-4 μm, both ends with a 8-30 x 2-4 μm gelatinous appendage, belonging to *Discosiëlla* sp.

Ecology and distribution: *Strigula lateralis* has been found on the west side of the Serra de Sintra, where it was growing on *Castanea sativa* in a mixed wood. The Serra de Sintra is situated near the atlantic coast of Portugal, on a peninsula North of Lisbon. Consequently it has a Mediterranean-Atlantic climate with subtropical tendencies and is rich in epiphytic lichens. Accompanying species are *Bacidia laurocerasi, Graphis elegans, Enterographa crassa, E. elaborata* and *Porina leptalea*. In Ireland it was found on *Corylus avellana*, together with e.g. *Pyrenula coryli* on a locality with many rare oceanic species, including *Calicium diploellum* on *Ilex aquifolium* (pers. comm. Dr. B. Coppins).

Additional material examined:
IRELAND: Fermanagh, Correl Glen National Nature Reserve, on *Corylus avellana*, 18 VII 1993, Coppins, O'Dare & Fox 15728 (E). This specimen has conidia (see above).

AUSTRALIA: Queensland, Kuranda, 33 km WNW, logging area in rain forest, alt. 800 m, 20 VII 1983, Hale 64169 (US, Herb. Aptroot, sub *Campylothelium* cf *amylosporum*). This specimen differs in the thallus, which is shiny, and the ascospores, which are generally smaller (18-21 x 7-8 μm). It may belong to a different species.

Discussion: this species differs from all other species of *Strigula* by the lateral ostiole and the truly muriform spores. Several other species of *Strigula* with muriform spores are known from tropical areas, but none have been described; only two species have submuriform spores. None of these has lateral ostioles.

2. **JULELLA LACTEA** (Massalongo) M.E. Barr, Sydowia 38: 13. 1986 ['1985']; *Blastodesmia lactea* Massalongo, Ricerch. Auton. Lich.: 181. 1852.
Type. ITALY (not seen).

Jullella lactea var. *naegelii* (Hepp) M.E. Barr, Sydowia 38: 13. 1986 ['1985']; *Pyrenula naegelii* Hepp, Flechten Europas 469. 1957; *Polyblastiopsis naegelii* (Hepp) Zahlbruckner in Engler-Prantl, Natürl. Pflanzenfamil. I,I*: 65. 1903. syn. nov.
Type. SWITZERLAND: Zürich (not seen, but already reduced to variety level by Barr (l.c.); topotype material (see below) agrees well).

Polyblastiopsis dispora (Müller Argoviensis) Zahlbruckner, Cat. Lich. Univ. 1: 348. 1922; *Polyblastia dispora* Müller Argoviensis, Flora 60: 79. 1877. syn. nov.
Type. U.S.A.: Texas (not seen). Synonymy probable, in view of identified material.

Polyblastiopsis alba (Müller Argoviensis) Zahlbruckner, Cat. Lich. Univ. 1: 347. 1922; *Polyblastia alba* Müller Argoviensis, Flora 69: 318. 1886. syn. nov.
Type. SOUTH AFRICA: Transvaal (not seen). Synonomy probable, in view of identified material.

Julella buxi Fabre, Ann. Sci. Nat., Bot. sér. 6, 9: 113. 1879.
Type. FRANCE: on *Buxus sempervirens* (not seen). syn. nov.
Synonymy probable, in view of the description of isotype material by Barr (1986) and examination of a topotype: Pyrenées Atlantiques, Gorge d'Ehujarre, on *Buxus sempervirens*, VII 1991, Diederich & Etayo 12032 (hb. Etayo).

Polyblastiopsis rappii Zahlbruckner, Ann. Mycol. 33: 36. 1935. syn. nov.
Type. U.S.A.: Florida, Sanford, on *Amorpha*. Rapp 97 (B, isotype).

Additional material examined:
PORTUGAL: Algarve, 14 km WSW of Lagos, on *Ficus*, 23 VII 1993, v. d. Boom 14971 (Herb. v. d. Boom).
FRANCE: Hyères, II 1867, Metzler (B).
GERMANY: 'St. Mauro', on *Fraxinus*, Stricker s. n., distributed in Koerber, Lichenes selecti Germaniae 381 (B).
SWITZERLAND: Zürich, on *Abies*, Hegetschweiler s. n. (B, sub *Polyblastiopsis naegelii*); same locality, on *Picea*, IV 1877, Winter (B, sub *Polyblastia naegelii*).

HUNGARY: Szörény, on *Fraxinus*, Lojka, Lichenes regni Hungarici exsiccati 149 (B, 3 collections, sub. *Verrucaria carrollii*).
UCRAINIA: Görz, on *Fraxinus ornus*, VI 1873, Glowacki s. n. (B).
U.S.A.: Florida, Dade County, Everglades, Sisal Pond, on branches, V 1989, Aptroot 26109 (Herb. Aptroot); Homestead, on roots of *Roystonea*, V 1989, Aptroot 26077 (Herb. Aptroot).
MEXICO: Baja California, Punta Santa Tomas, on *Euphorbia*, 2 I 1989, Aptroot 24309 (B, Herb. Aptroot).
PUERTO RICO: Ponce Distr., Reserva forestal de Guanica, on *Cactaceae*, V 1989, A. & M. Aptroot 25850 (Herb. Aptroot); Same locality, on tree, A. & M. Aptroot 25812 (Herb. Aptroot).
SRI LANKA: N. Province, Elephant's Pass, on *Acacia*, XI 1981, Meltzer s. n. (Herb. Aptroot).
PAPUA NEW GUINEA: Madang Prov., Boroi river, Bogia, on *Pandanus*, 24 VII 1992, Aptroot 30594 (Herb. Aptroot).

Discussion: this species differs from *J. vitrispora* only in the spores which are with less than 8 in the ascus. It remains to be seen whether this constitutes a valid species character.

3. **JULELLA SERICEA** (Massalongo) Coppins in Coppins, James & Hawksworth, Lichenologist 24: 367. 1992; *Polyblastia sericea* Massalongo, Symmict. Lich.: 99. 1855.

Polyblastiopsis fallacissima (Stizenberger) Zahlbruckner, Cat. Lich. Univ. 1: 348. 1922; *Verrucaria fallacissima* Stizenberger in Nylander, Not. F. Fl. Fenn. Förh. 8: 173. 1866. syn. nov.
Type: NORWAY: Sagebo, Rossbotten, Norman s. n. (B, isotype).

Julella fallaciosa (Stizenberger ex Arnold) R.C. Harris in Egan, Bryologist 90: 163. 1987; *Polyblastia fallaciosa* Stizenberger ex Arnold, Flora 46: 604. 1863. syn. nov.
Type: not seen.
This synonymy was already exspected by Coppins (in Purvis et al., 1992) and the numerous specimens cited below, which were mostly filed under this name, all belong to *J. sericea*.

Polyblastiopsis quercicola Brodo, Bull. N. Y. St. Mus. Sci. Surv. 410: 147. 1968.
Type. U.S.A.: New York, Long Island, on *Quercus*, Brodo (not seen). Synonymized before by Harris (1973). Topotype material also appeared to belong here: Aptroot 21551 (Herb. Aptroot).

Additional material examined:
PORTUGAL: Algarve, N. of Portimao, on *Olea*, 28 VII 1993, v. d. Boom 14779 (Herb. v. d. Boom).
SPAIN: Mallorca, Porto Cristo, on *Olea*, 14 VII 1994, Etayo s. n. (Herb. Etayo).
ITALY: Treviso, Montello, Beltramini s. n. (B, 2 collections).
GERMANY: Freiburg, on *Betula*, 21 IV 1916, Lettau s. n. (B); Westfalen, Wolbeck, on *Betula*, Bellebaum s. n. (B, 2 specimens); Frankfurt, on *Betula*,

Metzler s. n. (B); Bonn, on *Betula*, Dreesen s. n. (B); Heidelberg, on *Betula*, Zwackh s. n. (B); 'Rubbia', on *Quercus*, Stricker s. n., distributed in Koerber, Lichenes selecti Germaniae 410 (B).
POLAND: Breslau, on *Betula alba*, XII 1872, Stein s. n. (B).
UCRAINIA: Rubija, on *Quercus*, VI 1873, Glowacki s. n. (B, 2 specimens).
KABARDINO BALKARSKAYA: Caucasus, Tyrnyauz Distr., on *Betula*, 20 VI 1980, Vasák s. n. (B).
CANADA: Ontario, Renfrew County. On *Acer*, 21 VIII 1986, Wong 4231 (Herb. Aptroot).
U.S.A: Michigan, Cheboygan, on *Populus*, 19 VIII 1977, Hafellner s. n., Plantae Graecenses 166 (B); Minnesota, Afton State Park, on *Betula*, 13 X 1988, Wetmore 63164 (Herb. Aptroot); Pennsylvania, Centre County, on *Quercus*, XI 1987, Aptroot 21598A (Herb. Aptroot); New York, Long Island, Easthampton County, on *Quercus*, XI 1987, Aptroot 21551 (Herb. Aptroot); Missouri, St. Clair Co, on *Quercus*, 22 IV 1988, Harris 21286 (B).

4. **JULELLA VITRISPORA** (Cooke & Harkness) M.E. Barr, Sydowia 38: 13. 1986 ['1985']; *Pleospora vitrispora* Cooke & Harkness, Grevillea 9: 86. 1881.
Type. U.S.A.: California (not seen).

Julella sublactea (Nylander) R.C. Harris in Egan, Bryologist 90: 163. 1987; *Verrucaria sublactea* Nylander, Flora 69: 464. 1886. syn. nov.
Type: GREECE: Corfu ['Corcyra'], on *Olea*. (B, isotype).
The synonymy of this species with *Julella vitrispora* is probable according to the description of that species in Barr (1990).

Polyblastiopsis subargentea Zahlbruckner in H. Magnusson & Zahlbruckner, Arkiv. för Botanik 31A, 1: 12. 1944. syn. nov.
Type. HAWAII (not seen).
Synonymy probable, as shown by examination of topotype material: Oahu, Olomana, on *Acacia confusa*, 12 XI 1991, Smith 911211002 (B, Herb. Aptroot).

Additional material examined:
PORTUGAL: Algarve, 14 km WSW of Lagos, on *Ceratonia*, 23 VII 1993, v. d. Boom 14669 (Herb. v. d. Boom).
SPAIN: Ibiza, Cala Longa, on *Pinus halepensis* wood, 17 IV 1981, v. d. Aa 7831 (CBS).
U.S.A.: Florida, Dade Co., Everglades, on branches, VI 1989, A. & M. Aptroot 26165 (Herb. Aptroot); same locality, on *Taxodium*, 16 V 1967, Harris 2947a (B).
MEXICO: Baja California, Cerro Kenton, on *Euphorbia*, 4 I 1989, A. & M. Aptroot 24428 (Herb. Aptroot); Same locality, on shrub, 4 I 1989, A. & M. Aptroot 24455 (Herb. Aptroot).
GUYANA: Rupununi, Monkey Pond landing, on *Himatanthus*, Maas et al. 7371a (Herb. Aptroot).
PAPUA NEW GUINEA: Madang Prov., Tongu, on *Kwila*, 25 VII 1992, Aptroot 30677 (Herb. Aptroot); Central Prov., Motupore Island, 12 km SE of Port Moresby, on *Croton*, II 1987, Aptroot 17265 (Herb. Aptroot).

Excluded species

During the present study material has been examined from several other species of *Julella* and *Polyblastiopsis*. Some results of these examinations are given here.

Most other *Polyblastiopsis* species seen are currently placed in *Mycoglaena*. Barr (1990) treats five species from North America, not including any of the three species mentioned from the same area by Harris (1973). Material has been studied, pertaining to *M. acuminans* (Nylander) Vainio, *M. elegans* (Berkeley & Curtis) Höhnel, *M. meridionalis* (Zahlbruckner) Szatala, *M. myricae* (Nylander) R.C. Harris and *M. subcaerulescens* (Nylander) Höhnel, including fresh material, collected by the first author on Vancouver Island. All these collections might belong to one single species, because the differences mentioned by Barr (1990) are slight and many specimens seem to be transitional.

Polyblastiopsis amylospora (Vainio) Zahlbruckner, Cat. Lich. Univ. 1: 347. 1922; *Thelenella amylospora* Vainio, Étud. Lich. Brésil 2: 218. 1890; *Campylothelium amylosporum* (Vainio) R.C. Harris in Tucker & Harris, Bryologist 83: 7. 1980.
Type. BRAZIL: Rio de Janeiro (not seen).
According to Harris (1993) this is a synonym of the often lichen-forming *Polymeridium proponens* (Nylander) R.C. Harris.

Julella dactylospora Rehm, Hedwigia 40: 110. 1901.
Type. BRAZIL: St. Catharina, Serra Geral, on *Myrtaceae*, Ule 1800 (B, 2 isotypes).
The type belongs to the lichen *Anthracothecium columellatum* (Vainio) Zahlbruckner.

Polyblastiopsis dealbens Fink in Hedrick, Mycologia 25: 307. 1933.
Type. U.S.A.: South Carolina (not seen).
According to Harris (1993) this is a synonym of the often lichen-forming *Polymeridium proponens* (Nylander) R.C. Harris.

Julella luzonensis P. Hennings, Hedwigia 47: 257. 1908.
Type. PHILIPPINES: Luzon, Benguet Prov., Elmer 5937 (B, holotype).
Additional specimen: PHILIPPINES: On *Dysoxylon decandrum*, Baker s. n., distributed in Reliquiae Petrakianae 2659 (B).
Both specimens belong to the lichen *Anthracothecium prasinum* (Eschweiler) R.C. Harris.

Polyblastiopsis proponens (Nylander) Zahlbruckner, Cat. Lich. Univ. 1: 351. 1922; *Verrucaria proponens* Nylander, Bull. Soc. Linn. Normandie, sér. 2, 2: 130. 1868; *Polymeridium proponens* (Nylander) R.C. Harris, Bol. Mus. Para Emílio Goeldi, sér. Bot. 7: 637. 1993 ['1991'].
Type. LOYALTY ISLANDS: Lifu (not seen).
According to Harris (1993) this is the often lichen-forming *Polymeridium proponens* (Nylander) R.C. Harris.
Material studied:
AUSTRALIA: Queensland, Bartle Frere, 15 VIII 1987, Lumbsch 5412b (Herb. Lumbsch, Herb. Aptroot)

PAPUA NEW GUINEA: Central prov., Varirata, 5 II 1981, Streimann & Vinas 14464 (CBG, Herb. Aptroot).

Polyblastiopsis transwaalensis (Müller Argoviensis) Zahlbruckner, Cat. Lich. Univ. 1: 353. 1922.
Type. SOUTH AFRICA: Transvaal, Lydenburg. Wilms s. n. (B, isotype).
The type belongs to the lichen *Anisomeridium subprostans* (Nylander) R.C. Harris.

Julella zenkeriana P. Hennings, Bot. Jahrb. Syst. 38: 127. 1905.
Type. CAMEROUN: Bipinde, Zenker 1980 (B, holotype).
The type belongs to the lichen *Laurera megasperma* (Montagne) Riddle.

Acknowledgements: We are indebted to the curators of the herbaria B, CBG, E, L, US, Herb. Etayo and Herb. Lumbsch who kindly let us examine the collections under their care, and to Dr H. Sipman for comments on the text. We are especially indebted to Dr E. Sérusiaux, who attracted our attention to an additional specimen of the new species and to the presence of *Strigula*-like conidia in it.

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DEMATIACEOUS HYPHOMYCETES ON PANDANACEAE. 5. SPORIDESMIUM SENSU LATO

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Abstract

Thirteen species of *Sporidesmium* sens. lat. found during an examination of dead leaves of *Freycinetia* and of *Pandanus* are described and figured in the genera *Ellisembia, Penzigomyces, Repetophragma, Sporidesmium* and *Stanjehughesia*. These include three new species of *Ellisembia* and one of *Sporidesmium*. New combinations are made in *Ellisembia, Repetophragma* and *Stanjehughesia*.

Keywords *Ellisembia; Penzigomyces; Repetophragma; Sporidesmium; Stanjehughesia*; microfungi; *Freycinetia; Pandanus*

Introduction

To date, this series of papers (e.g., McKenzie 1991, McKenzie & Kuthubutheen 1993) has been restricted to hyphomycetes on *Freycinetia*, one of three genera in the Pandanaceae. The study has now widened to include hyphomycetes on dead leaves of *Pandanus*, the screwpines. There are approximately 600 species of *Pandanus*, principally in the Old World tropics, but a few are warm temperate. They are usually trees with prop-roots, characteristically found on the coast, sometimes in thick groves, but extending to montane forests. Some species are cultivated as ornamentals. The leaf fibre from several species is traditionally plaited into mats, baskets, fans, sails and garments, and is used for house thatch.

During this study 13 species of *Sporidesmium* sens. lat. were found, making it the most diverse of the hyphomycete genera found on Pandanaceae. It occurred on *Freycinetia* from all the tropical countries sampled (American Samoa, Cook Islands, Fiji, Hawaii, Indonesia, Malaysia, New Caledonia, Palau, Solomon Islands and Western Samoa). However, it was less common in temperate New Zealand, where only two of a large number of collections yielded *Sporides-*

mium. *Pandanus* samples collected in Brunei, Hong Kong and Malaysia have all yielded species of *Sporidesmium*.

Sporidesmium sens. lat. is worldwide in distribution, often found on wood or on plant litter. Many species have been described and illustrated (e.g., Ellis 1958, 1971, 1976). It is a large, disparate genus which has been recently reassessed by Subramanian (1992). He erected five genera to accommodate most species, which he separated primarily on the basis of conidial septation (euseptate versus distoseptate) and conidiogenesis. Euseptate species which either lack or have irregular conidiophore proliferations remain in *Sporidesmium* Link. Other species with euseptate conidia and with annellate conidiophores were placed in *Repetophragma* Subram., those with lageniform, ovoid, doliform or nodose percurrent proliferations in *Penzigomyces* Subram., and those with the conidiophore reduced to a conidiogenous cell in *Stanjehughesia* Subram. Species with distoseptate conidia have been placed in three genera: those with irregular conidiophore proliferations in *Ellisembia* Subram., those with regular annellations in *Sporidesmiella* P.M. Kirk, and those with lageniform, ovoid or doliform percurrent proliferations in *Polydesmus* Mont.

This paper describes and illustrates 3 new species of *Ellisembia* and one of *Sporidesmium*, and 8 named species, including three new combinations, previously described from other substrates, and now placed in *Ellisembia*, *Penzigomyces*, *Repetophragma* and *Stanjehughesia*. The remaining species appears to be an undescribed *Sporidesmium*, but lacks sufficient material for a formal description. Three additional new combinations are made in *Ellisembia*.

All specimens were mounted in hydrous lactophenol.

Ellisembia adscendens (Berk.) Subram., *Proceedings of the Indian National Science Academy B 58*: 183, 1992 [Fig. 1]
Sporidesmium adscendens Berk., *Annals of Natural History 4*: 291, 1840

Mycelium mostly immersed. Conidiophores macronematous, mononematous, single or in groups of 2 or 3, unbranched, erect, straight or slightly curved, smooth, septate, pale reddish-brown, up to 35 µm long x 5-10 µm thick. Conidiogenous cells monoblastic, integrated, terminal, determinate, cylindrical. Conidia solitary, acrogenous, reddish-brown, paler towards the apex, flexuous, obclavate, elongated, apex rounded, base conico-truncate, smooth, 19-43 distoseptate, constricted at some septa, 90-255 µm long x 14-21 (-22.5) µm wide in the broadest part, tapering to 4-10 (-14) µm near the apex, 3.5-7.5 µm at the base.

Specimens examined:
On *Freycinetia arborea* Gaud.
Hawaii, Oahu, Manoa Valley, 24.IX.1990, E.H.C. McKenzie & D.E. Gardner (PDD 57944).

On *Freycinetia* sp.
Malaysia, Genting Highlands, Ganung Bunga Buah, 18.VIII.1992, E.H.C. McKenzie (PDD 60540).
On *Pandanus furcatus* Roxb.
Hong Kong, Hong Kong Island, Victoria Peak, 20.III.1994, E.H.C. McKenzie & K.D. Hyde (PDD 63344); Pok Fulam Reservoir, 20.III.1994, M. Dickman (PDD 63342); New Territories, Tai Mo Shan, 23.III.1994, E.H.C. McKenzie (PDD 63345); Sai Kung Peninsula, 1.IV.1994, E.H.C. McKenzie & K.D. Hyde (PDD 63343).
On *Pandanus* sp.
Malaysia, Genting Highlands, Gombak Field Centre, 10.VIII.1992, E.H.C. McKenzie (PDD 60542); Kuala Lumpur, University of Malaya, Botanical Gardens, 12.VIII.1992, E.H.C. McKenzie (PDD 60541).

The collections of this fungus match the description given by Ellis (1958). It is widely distributed, usually on woody substrates.

Ellisembia brachypus (Ellis & Everh.) Subram., *Proceedings of the Indian National Science Academy B 58*: 183, 1992 [Fig. 2]
Sporidesmium brachypus (Ellis & Everh.) Hughes, *Canadian Journal of Botany 36*: 807, 1958

Mycelium partly superficial, partly immersed, pale yellowish, 1.5-2.5 µm thick. Conidiophores macronematous, mononematous, single, unbranched, erect, straight or slightly flexuous, smooth, septate, reddish-brown, paler towards the apex, up to 220 µm long x 6.5-7 µm thick at base, tapering to 4-5 µm at apex, which is often conico-truncate. Conidiogenous cells monoblastic, integrated, terminal, determinate, sometimes percurrent, cylindrical, tapering towards the apex. Conidia solitary, acrogenous, straw-coloured, straight, navicular with a filiform beak, base conico-truncate, smooth, 7-11 distoseptate, 37-65 µm long excluding the beak, 8-10 (-16) µm wide in the broadest part, 3-4 µm at the base; filiform beak hyaline, ca. 15-35 µm long x 1-2 µm wide.

Specimens examined:
On *Freycinetia banksii* Cunn.
New Zealand, Northland, Waipoua Forest, Yakas Kauri Track, 14.V.1986, P.K. Buchanan (PDD 57491).
On *Pandanus furcatus* Roxb.
Hong Kong, Hong Kong Island, Victoria Peak, 20.III.1994, E.H.C. McKenzie & K.D Hyde (PDD 63341); New Territories, Tai Mo Shan, 23.III.1994, E.H.C. McKenzie (PDD 63338).

This species has been recorded on litter of several plant species, from the USA and Sierra Leone (Ellis 1971), Taiwan (Matsushima 1980) and Japan (Matsushima 1975). Hughes (1978) recorded it on dead stems of *Ripogonum scandens* in New Zealand.

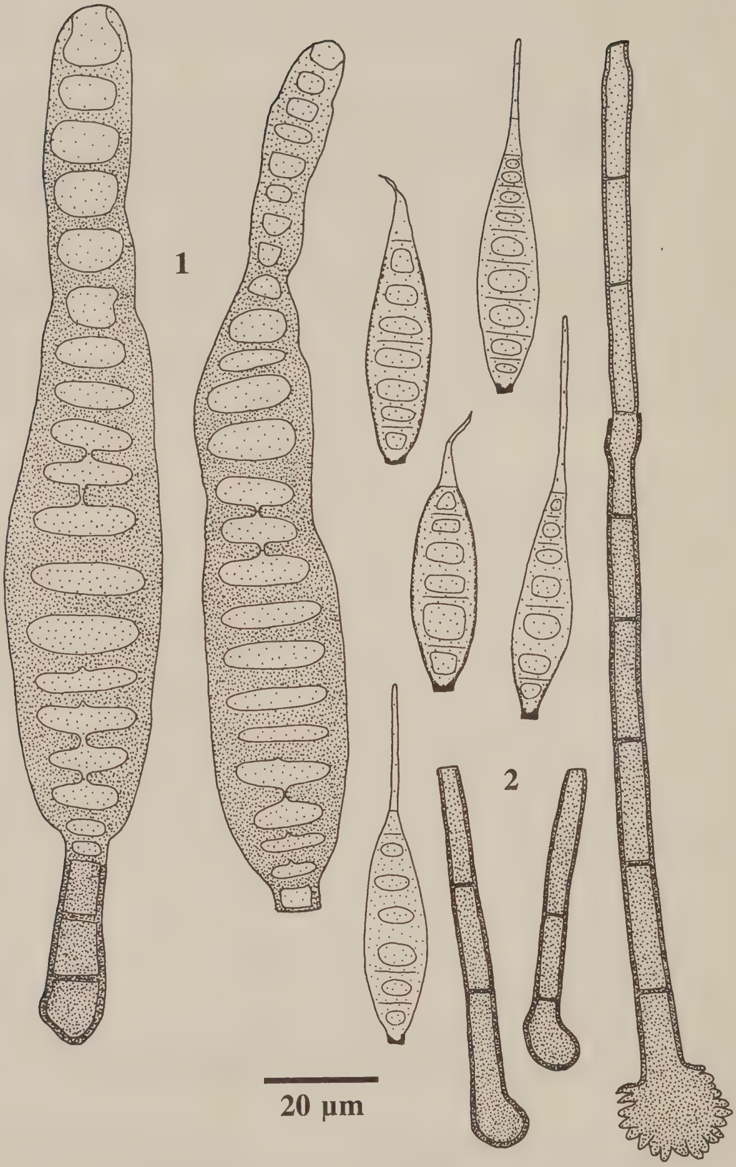

Figure 1 *Ellisembia adscendens*, conidiophore and conidia (PDD 60540).
Figure 2 *Ellisembia brachypus*, conidiophores and conidia (PDD 57491).

Ellisembia leonensis (M.B. Ellis) McKenzie comb. nov. [Fig. 3]
Sporidesmium leonense M.B. Ellis, *Mycological Papers 70*: 28, 1958

Mycelium mostly immersed. Conidiophores macronematous, mononematous, single, usually unbranched, erect, straight or slightly flexuous, smooth, septate, brown, paler towards the apex, up to 175 µm long x 6-7 µm thick at base, tapering to 3.5-4.5 µm at apex, which is often conico-truncate. Conidiogenous cells monoblastic, integrated, terminal, determinate, cylindrical, tapering towards the apex. Conidia solitary, acrogenous, brown, basal cell and apical cells paler, straight or slightly flexuous, obclavate, usually rostrate, apex rounded, base conico-truncate, smooth, 7-12 distoseptate, (38-) 50-75 (-85) µm long x 11-15 µm wide in the broadest part, tapering to 2.5-3.25 µm near the apex, 1.5-3 µm at the base.

Specimen examined:
On *Freycinetia* sp.
Malaysia, Genting Highlands, Ganung Bunga Buah, 18.VIII.1992, E.H.C. McKenzie (PDD 60553).

This species was described from West Africa by Ellis (1958). In the original description the conidia are wider, 15-18 µm in the broadest part, 4-5.5 µm at the base.

Ellisembia palauensis McKenzie sp. nov. [Fig. 4]

Mycelium plerumque internum. Conidiophora macronematosa, mononematosa, solitaria vel parce aggregata, eramosa, erecta, recta vel paulo flexuosa, laevia, septata, brunnea vel rubro-brunnea, interdum apicem versus pallidiora, 80-130 µm longa, ad basim 5-7 µm lata, ad apicem 2.75-3.5 µm et conico-truncata. Cellulae conidiogenae monoblasticae, in conidiophora incorporatae, terminales, determinatae, cylindricae, apicem versus fastigatae. Conidia solitaria, acrogenosa, brunnea, apicem et basim versus interdum pallidiora, recta vel paulo curvata, obclavata vel fusoidea, interdum rostrata, laevia, 7-11 distoseptata, 40-70 µm longa x 9.5-17.5 µm lata; cellula apicalis rotundata, 2-5 µm lata; cellula basalis conice truncata, 2.75-3 (-3.5) µm lata.

Holotypus PDD 60918.

Mycelium mostly immersed. Conidiophores macronematous, mononematous, single or in groups of 2 or 3, unbranched, erect, straight or slightly flexuous, smooth, septate, brown or reddish-brown, sometimes paler towards the apex, 80-130 µm long x 5-7 µm thick at base, tapering to 2.75-3.5 µm at apex, which is conico-truncate. Conidiogenous cells monoblastic, integrated, terminal, determinate, cylindrical, tapered towards the apex. Conidia solitary, acrogenous, brown, basal cell and apical cells sometimes paler, straight or slightly curved, obclavate or fusoid, sometimes rostrate, apex rounded, base conico-truncate,

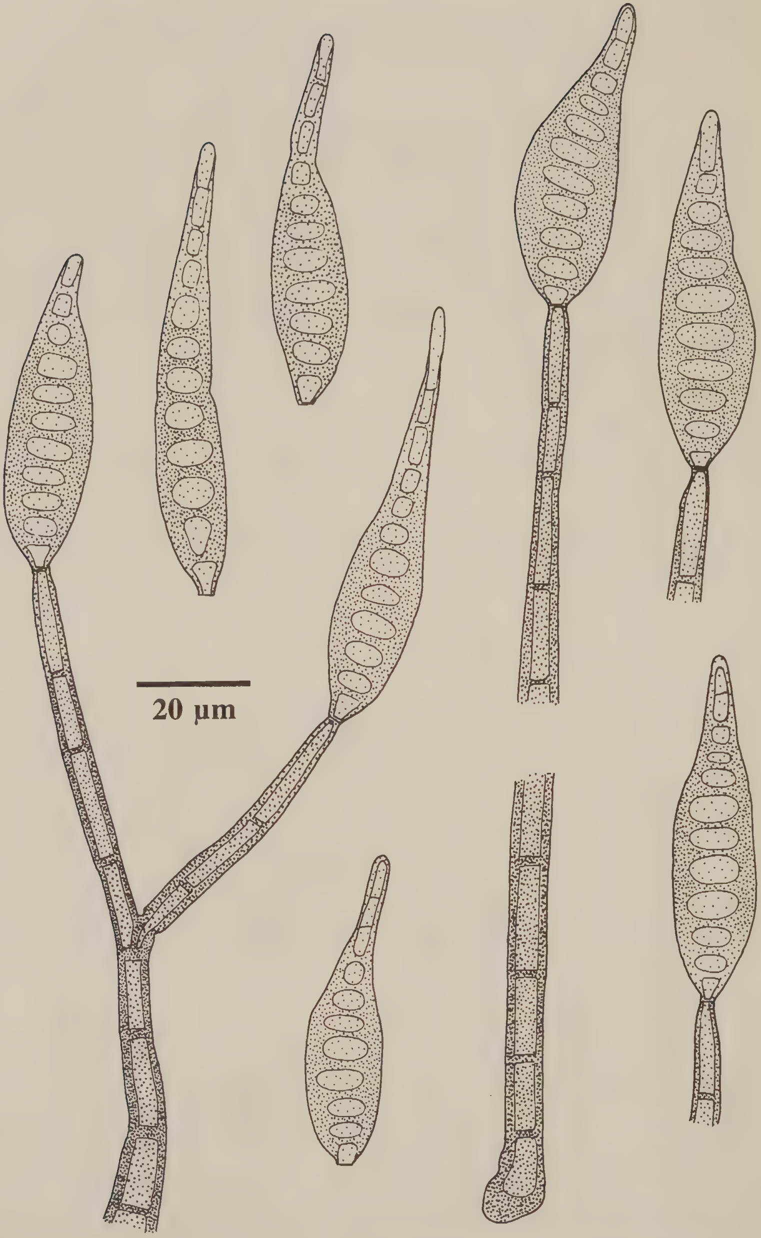

Figure 3 *Ellisembia leonensis*, conidiophores and conidia (PDD 60553).

smooth, 7-11 distoseptate, 40-70 µm long x 9.5-17.5 µm wide in the broadest part, tapering to 2-5 µm near the apex, 2.75-3 (-3.5) µm at the base.

Specimen examined:
On *Freycinetia* sp.
Palau, Babeldaob, 10.VIII.1991, E.H.C. McKenzie (PDD 60918 - **holotype**).

The specific epithet refers to the country of origin.

This species is similar to *Ellisembia coronata* (Fuckel) Subram. and to ***E. bambusina*** (N.D. Sharma) McKenzie comb. nov. (basionym, *Sporidesmium bambusinum* N.D. Sharma, *Journal of the Indian Botanical Society 59*: 76, 1980). However, the conidiophores of *E. coronata* are shorter (10-70 µm) and the conidia are narrower (9-12 µm), but with a wider apex (3-8 µm) and a wider base (4-6 µm). *E. coronata* is known from Europe. *E. bambusina* has shorter conidia (33-48 µm) which are more regular in shape.

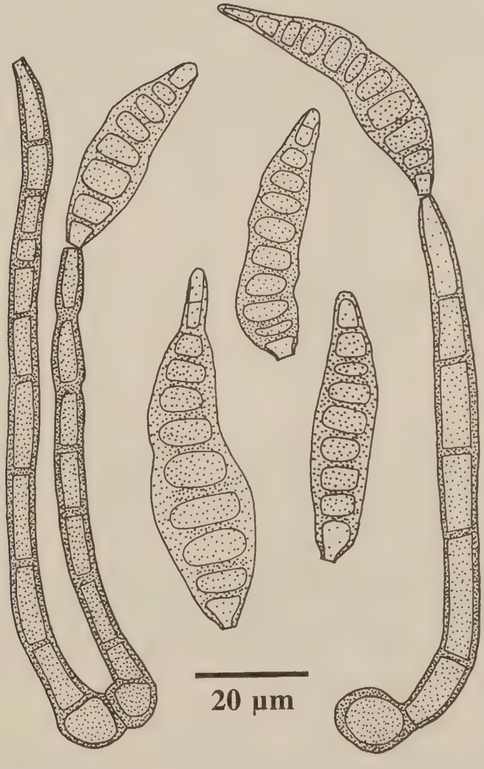

Figure 4 *Ellisembia palauensis*, conidiophores and conidia (PDD 60918 - type).

Ellisembia paravaginata McKenzie sp. nov. [Fig. 5]

Mycelium plerumque internum. Conidiophora e cellulis brunneis orientia, macronematosa, mononematosa, solitaria, eramosa, erecta, recta vel paulo flexuosa, laevia, septata, pallide brunnea, 55-85 µm longa, 3-5.25 µm lata. Cellulae conidiogenae monoblasticae, in conidiophora incorporatae, terminales, determinatae, cylindricae. Conidia solitaria, acrogenosa, brunnea, apicem et basim versus pallidiora, recta, obclavata vel fusoidea, laevia, 10-12 septata, 55-70 µm longa x (9.5-) 12-14.5 µm lata, apice calyptra gelatinosa praedita; cellula apicalis rotundata, 2.5-3.25 µm lata; cellula basalis conice truncata, 3.25-4 µm lata.

Holotypus PDD 60538.

Mycelium mostly immersed. Conidiophores originating from brown, smooth, usually swollen cells up to 13 µm wide, macronematous, mononematous, single, unbranched, erect, straight or slightly flexuous, smooth, septate, pale brown, 55-85 µm long x 3-5.25 µm thick. Conidiogenous cells monoblastic, integrated, terminal, determinate, cylindrical. Conidia solitary, acrogenous, brown, basal and apical cells pale, straight, obclavate or fusoid, apex rounded and surrounded by a mucilaginous sheath, base conico-truncate, smooth, 10-12 septate, basal septum and apical septa euseptate, others distoseptate, 55-70 µm long x (9.5-) 12-14.5 µm wide in the broadest part, tapering to 2.5-3.25 µm near the apex, 3.25-4 µm at the base.

Specimen examined:
On *Pandanus* sp.
Malaysia, Kuala Lumpur, University of Malaya, Botanical Gardens, 12.VIII.-1992, E.H.C. McKenzie (PDD 60538 - **holotype**).

The specific epithet refers to the similarity of this species to *E. vaginata* McKenzie (see below).

This species is most similar to ***Ellisembia antillana*** (R.F. Castañeda & W.B. Kendr.) McKenzie comb. nov. (basionym, *Sporidesmium antillanum* R.F. Castañeda & W.B. Kendrick, *University of Waterloo Biology Series 32*: 39, 1990), *E. gelatinosa* (Matsush.) Subram., *S. minigelatinosum* Matsush. and *E. vaginata*. However, *E. antillana* has wider conidia (16-20 µm) and a noticeably pointed, appendage-like apical cell. *E. gelatinosa* has only 4-7 septa in the conidia, and both the basal cell and the conidium differ in shape from that of *E. paravaginata*. *Sporidesmium minigelatinosum* has both smaller conidia (36-50 x 6-8 µm) and shorter conidiophores (5-15 µm). The newly described *E. vaginata* has smaller conidia.

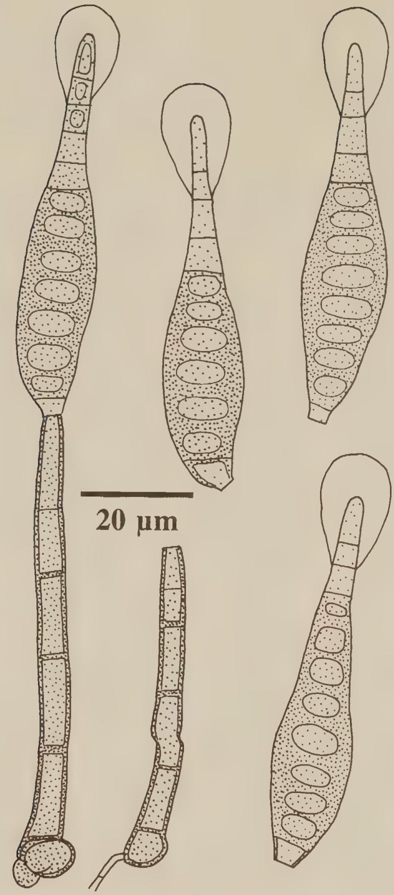

Figure 5 *Ellisembia paravaginata*, conidiophores and conidia (PDD 60538 - type).

Ellisembia vaga (Nees & T. Nees) Subram., *Proceedings of the Indian National Science Academy B 58*: 184, 1992 [Fig. 6]
Sporidesmium vagum Nees & T. Nees ex Link, *Willdenow, Species Plantarum, Ed. 5, 6(2)*: 120, 1825

Mycelium mostly immersed. Conidiophores macronematous, mononematous, single or in groups of 2 or 3, unbranched, erect, straight or slightly curved, smooth, septate, pale brown, up to 20 µm long x 5-6.5 µm thick. Conidiogenous cells monoblastic, integrated, terminal, determinate, cylindrical. Conidia soli-

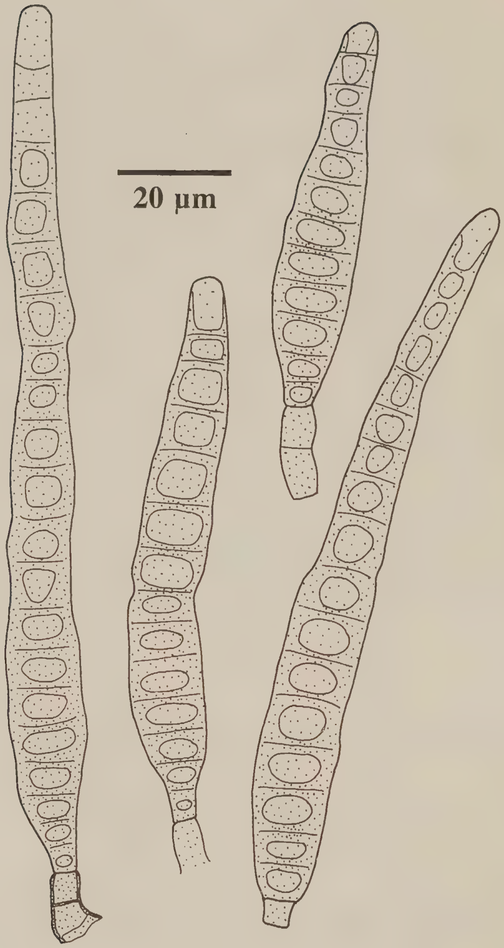

Figure 6 *Ellisembia vaga*, conidiophores and conidia (PDD 57503).

tary acrogenous, pale brown, paler towards the apex, flexuous, obclavate, elongated, apex rounded, base conico-truncate, smooth, 12-33 distoseptate, sometimes slightly constricted at the pseudosepta, 90-240 µm long x 12-16 µm wide in the broadest part, tapering to 4.5-7.5 µm near the apex, 4-5.5 (-6) µm at the base.

Specimens examined:
On *Freycinetia wilderi* Mart.
Cook Islands, Rarotonga, Apr. 1985, P.S. Dale (PDD 57502).
On *Freycinetia* sp.
Western Samoa, Upolu, Afiamalu, 12.XII.1985, E.H.C. McKenzie (PDD 57-503).

The collections of this fungus match the description given by Ellis (1958). It is widely distributed, usually on woody substrates.

Ellisembia vaginata McKenzie sp. nov. [Fig. 7]

Mycelium plerumque internum. Conidiophora e cellulis brunneis orientia, macronematosa, mononematosa, solitaria, eramosa, erecta, recta vel paulo flexuosa, laevia, septata, brunnea, interdum apicem versus pallidiora, 30-60 (-110) µm longa, 3.5-5.5 µm lata. Cellulae conidiogenae monoblasticae, in conidiophora incorporatae, terminales, determinatae, cylindricae. Conidia solitaria, acrogenosa, pallide straminea, recta vel paulo curvata, obclavata, laevia, 7-11 distoseptata, 30-50 µm longa x 7-11 µm lata, apice calyptra gelatinosa praedita; cellula apicalis rotundata, 2-3 µm lata; cellula basalis conice truncata, 2.5-4.5 µm lata.

Holotypus PDD 63340.

Mycelium mostly immersed. Conidiophores originating from brown, smooth, usually swollen cells up to 8 µm wide, macronematous, mononematous, single, unbranched, erect, straight or slightly flexuous, smooth, septate, brown, sometimes paler towards the apex, 30-60 (-110) µm long x 3.5-5.5 µm thick. Conidiogenous cells monoblastic, integrated, terminal, determinate, cylindrical. Conidia solitary, acrogenous, pale straw-coloured, straight or slightly curved, obclavate, apex rounded and surrounded by a conspicuous, sharply delimited mucilaginous sheath, base conico-truncate, smooth, 7-11 distoseptate, 30-50 µm long x 7-11 µm wide in the broadest part, tapering to 2-3 µm near the apex, 2.5-4.5 µm at the base.

Specimens examined:
On *Freycinetia* sp.
American Samoa, Tutuila, 4.V.1989, E.H.C. McKenzie (PDD 57494). **Fiji**, Viti Levu, Colo-i-Suva, 27.II.1992, E.H.C. McKenzie & P.A. Maddison (PDD 60920). **New Caledonia**, Mt des Koghis, 25.II.1994, E.H.C. McKenzie & T.K. Crosby (PDD 63340 - **holotype**).
On *Pandanus* sp.
Brunei, K.D. Hyde, Mar. 1994 (PDD 63339).

The specific epithet refers to the mucilaginous sheath.

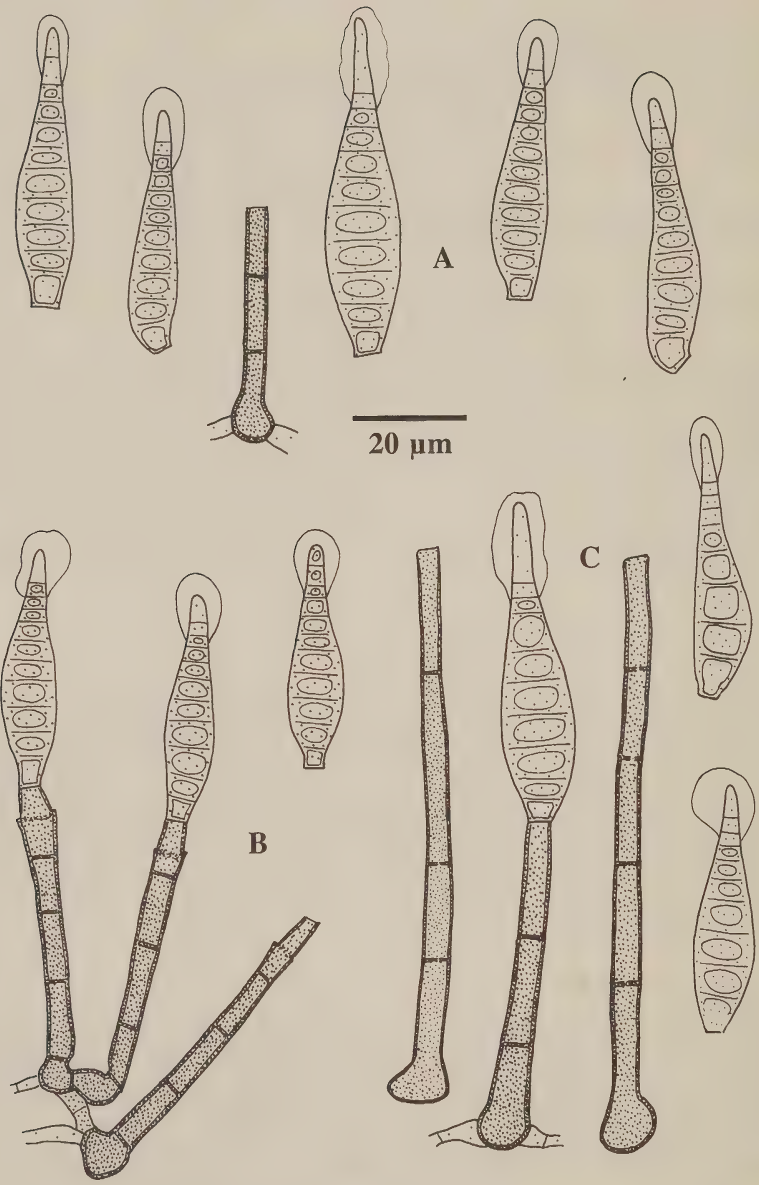

Figure 7 *Ellisembia vaginata*, conidiophores and conidia (A, PDD 63339; B, PDD 63340 - type; C, PDD 60920).

There are at least 9 previously described species of *Sporidesmium* sens. lat. with a mucilaginous sheath enveloping the conidial apex. Of these, *E. vaginata* is most similar to *E. gelatinosa* and *S. minigelatinosum*. However, conidia of *E. gelatinosa* have fewer septa (4-7) and a differently shaped basal cell, while *S. minigelatinosum* has narrower conidia (6-8 µm) and short conidiophores (5-15 µm) which are often non-septate. *E. vaginata* is also similar to *E. antillana*, although the latter has wider conidia (16-20 µm) and a projecting basal cell, and it possesses a noticeably pointed, appendage-like apical cell. The newly described *E. paravaginata* has larger and darker conidia.

Penzigomyces cookei (Hughes) Subram., *Proceedings of the Indian National Science Academy B 58*: 186, 1992 [Fig. 8]
Sporidesmium cookei (Hughes) M.B. Ellis, *Mycological Papers 70*: 48, 1958

Mycelium mostly immersed. Conidiophores originating from brown, smooth, usually swollen cells up to 15 µm wide, macronematous, mononematous, single, unbranched, erect, straight or slightly flexuous, smooth, septate, brown, paler towards the apex, up to 130 µm long x 3-4 µm thick. Conidiogenous cells monoblastic, integrated, terminal, determinate, sometimes percurrent, cylindrical. Conidia solitary, acrogenous, lower cells brown and verruculose, upper cells paler and smooth, straight or slightly curved, obpyriform, apex rounded, base conico-truncate and protruding, 3 euseptate, often slightly constricted at the septa, 19-24 µm long x 10-11 µm wide in the broadest part, tapering to 2-3 µm near the apex and at the base.

Specimen examined:
On *Freycinetia baueriana* Endl. ssp. *banksii* (Cunn.) Stone
New Zealand, Nelson, Abel Tasman National Park, Anapai Bay to Totaranui, 14.II.1987, V. & R.C. Cooper (PDD 52962).

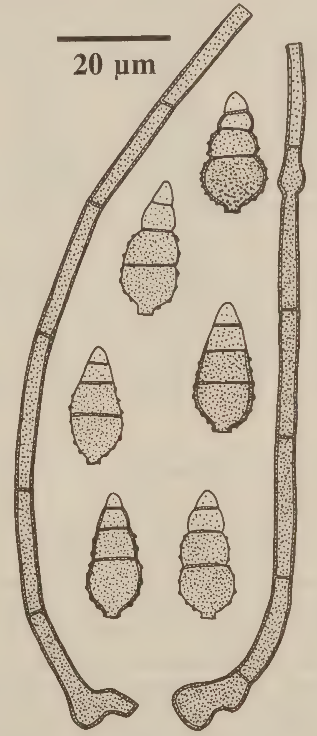

Figure 8 *Penzigomyces cookei*, conidiophores and conidia (PDD 52962).

The collection of this fungus matches the description given by Ellis (1958). Originally described from Europe on dead plant material, it is now known also from Taiwan, Japan (Matsushima 1983) and Papua New Guinea (Matsushima 1971).

Repetophragma cambrense (M.B. Ellis) McKenzie comb. nov. [Fig. 9]
Sporidesmium cambrense M.B. Ellis, *Mycological Papers 70*: 44, 1958

Mycelium mostly immersed. Conidiophores macronematous, mononematous, single or in groups of 2 or 3, unbranched, erect, straight or flexuous, smooth, septate, reddish brown, paler towards the apex, up to 125 µm long x 6.5-9.5 µm thick. Conidiogenous cells monoblastic, integrated, terminal, determinate, percurrent. Conidia solitary, acrogenous, brown, cell at each end often paler, straight, subfusiform, apex rounded, base truncate with a conspicuous marginal fringe, smooth, 7-10 euseptate, (47-) 53-63 (-70) µm long x (9-) 10-14 µm wide in the broadest part, tapering to (5-) 6-7.5 µm near the apex, 8-9 µm at the base.

Specimen examined:
On *Freycinetia arborea* Gaud.
Hawaii, Oahu, Manoa Valley, 24.IX.1990, E.H.C. McKenzie & D.E. Gardner (PDD 60922).

This fungus was described on gorse (*Ulex europaeus*) from Wales, and has since been reported on wood and bark in England (Ellis 1976) and Taiwan (Matsushima 1980). The present collection matches the type description in all details. The presence of a marginal fringe at the base of the conidia is distinctive. Although this feature was not mentioned in the original description, some of the conidia were drawn with a fringe.

Sporidesmium freycinetiae McKenzie sp. nov. [Fig. 10]

Mycelium plerumque internum, ex hyphis stramineis, 1-2 µm crassis compositum. Conidiophora e cellulis brunneis orientia, macronematosa, mononematosa, solitaria vel parce aggregata, eramosa, erecta, recta vel paulo flexuosa, laevia, septata, brunnea, usque ad 120 µm longa, 5-6 (-7) µm lata. Cellulae conidiogenae monoblasticae, in conidiophora incorporatae, terminales, determinatae, interdum percurrentes, cylindricae. Conidia solitaria, acrogenosa, brunnea, apicem versus pallidiora, ad basim obscure brunnea, recta vel curvata, fusiformia vel obclavata, laevia, (5-) 6-7 (-8) euseptata, ad quodque septum annulo atro praedita, 54-83 µm longa x 7-12 µm lata; cellula apicalis rotundata, 2-4 µm lata, cellula basalis conice truncata, 4-5 µm lata.

Holotypus PDD 57499.

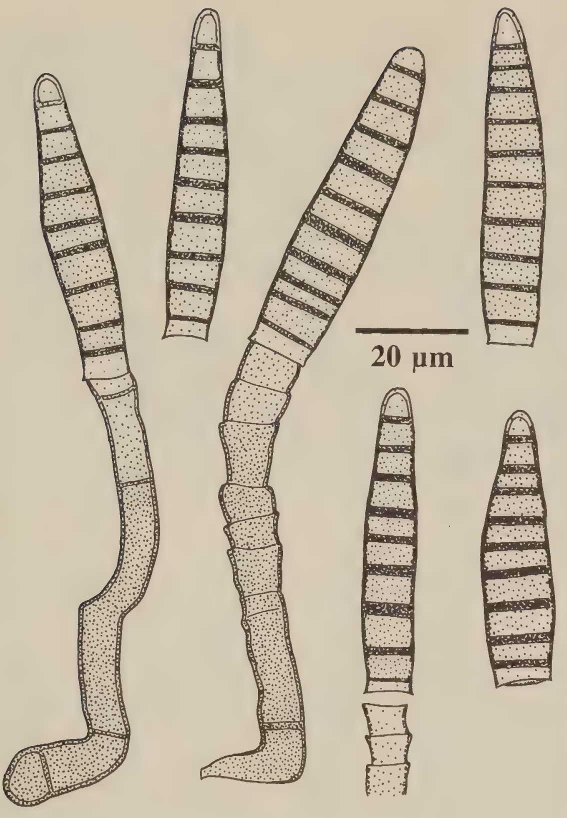

Figure 9 *Repetophragma cambrense*, conidiophores and conidia (PDD 60922).

Mycelium mostly immersed, pale straw-coloured, 1-2 µm thick. Conidiophores originating from brown, smooth, usually swollen cells up to 20 µm wide, macronematous, mononematous, single or in groups of 2-4, unbranched, erect, straight or slightly flexuous, smooth, septate, brown, up to 120 µm long x 5-6 (-7) µm thick. Conidiogenous cells monoblastic, integrated, terminal, determinate, sometimes percurrent, cylindrical. Conidia solitary, acrogenous, brown, paler towards the apex, dark brown at the base, straight or curved, fusiform or obclavate, apex rounded, base conico-truncate, smooth, (5-) 6-7 (-8) euseptate, with wide dark bands at the septa, 54-83 µm long x 7-12 µm wide in the broadest part, tapering to 2-4 µm near the apex, 4-5 µm at the base.

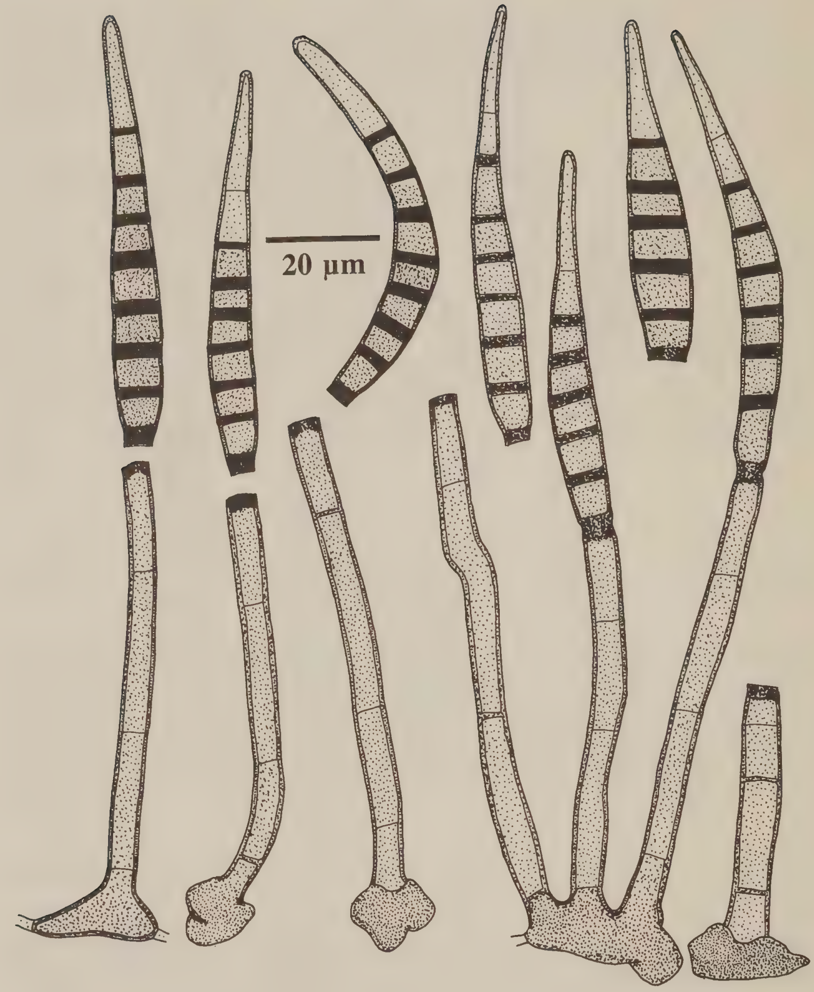

Figure 10 *Sporidesmium freycinetiae*, conidiophores and conidia (PDD 57499 - type).

Specimens examined:
On *Freycinetia ?graminifolia* Solms
New Caledonia, Mt Panié, 1300 m, 15.XII.1990, J.S. Dugdale (PDD 58427).
On *Freycinetia wilderi* Mart.
Cook Islands, Rarotonga, Apr. 1985, P.S. Dale (PDD 57499 - **holotype**); track to south of Te Rua Manga, 9.IX.1987, R.E. Beever (PDD 57500); Cross Island Track, 24.VI.1990, G. McCormack (PDD 57667).
On *Freycinetia* sp.
American Samoa, Tutuila, Mt Alva Track, 9.XI.1985, P.A. Maddison (PDD 57501). **Indonesia**, Sulawesi, Dumoga-Bone National Park, summit Gn. Poniki, 17.X.1985, G.J. Samuels (PDD 50360).

The specific epithet refers to the host genus.

This species is, perhaps, most similar to *Sporidesmium ehrenbergii* M.B. Ellis and to *S. rubi* M.B. Ellis. It differs, however, in several features including number of conidial septa and length of conidiophores. *S. freycinetiae* also possesses a distinct dark scar at the base of the conidium and at the apex of the conidiogenous cell.

Sporidesmium tropicale var. ***tropicale*** M.B. Ellis, *Mycological Papers 70*: 58, 1958 [Fig. 11]

Mycelium mostly immersed. Conidiophores macronematous, mononematous, single or in groups of 2 or 3, unbranched, erect, straight or slightly curved, smooth, septate, reddish-brown, paler towards the apex, up to 315 µm long x 5.5-8 µm thick at base, tapering to 2.5-3 µm at apex, which is often conico-truncate. Conidiogenous cells monoblastic, integrated, terminal, determinate, cylindrical, tapering towards the apex. Conidia solitary, acrogenous, brown, basal cell and apical cells paler and smooth, straight or slightly curved, obclavate, rostrate, apex rounded, base conico-truncate, middle cells verrucose, 10-12 euseptate, 70-110 µm long x 12-16 µm wide in the broadest part, tapering to 2.5-3.25 µm near the apex, 2.5-3 µm at the base.

Specimen examined:
On *Freycinetia* sp.
Fiji, Viti Levu, Colo-i-Suva, 27.II.1992, E.H.C. McKenzie & P.A. Maddison (PDD 60921).

This species is widespread in tropical areas, usually on dead branches of shrubs and trees (Ellis 1971, Matsushima 1971, 1980).

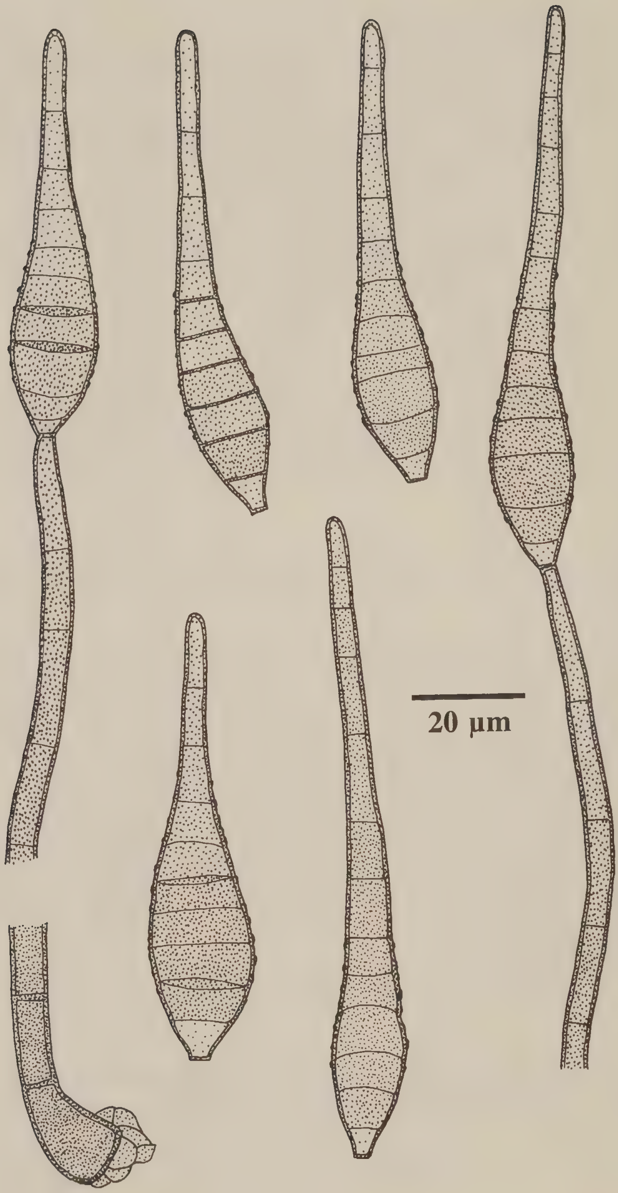

Figure 11 *Sporidesmium tropicale* conidiophores and conidia (PDD 60921).

***Sporidesmium* sp.** [Fig. 12]

Mycelium mostly immersed. Conidiophores originating from brown, smooth, usually swollen cells up to 10 µm wide, macronematous, mononematous, single, unbranched, erect, straight or slightly flexuous, smooth, septate, brown, paler towards the apex, up to 110 µm long x 2.5-4 µm thick. Conidiogenous cells monoblastic, integrated, terminal, determinate, sometimes percurrent, cylindrical. Conidia solitary, acrogenous, lower cells brown, upper cells pale, straight or slightly curved, obclavate, apex acuminate, base rounded-truncate and protruding, smooth, 3 euseptate, constricted at the septa, 17-28 µm long x 5-6 µm wide in the broadest part, tapering to 0.5-1 µm near the apex, 1.5 µm at the base.

Specimen examined:
On *Freycinetia* sp.
Solomon Islands, Guadalcanal, Mt Austen, 23.III.1986, E.H.C. McKenzie (PDD 57493).

This species appears to be distinct from any described *Sporidesmium* sens. lat. Unfortunately, the specimen is too sparse to serve as the type for a new species. It can be compared to several species which are similar in shape and septation. However, only *Penzigomyces coffeicola* (M.B. Ellis) Subram. and *S. occidentale* R.F. Castañeda are similar in size, but they differ in other features.

Stanjehughesia decorosa (R.F. Castañeda & W.B. Kendr.) McKenzie comb. nov. [Fig. 13]
Sporidesmium decorosum R.F. Castañeda & W.B. Kendrick, *University of Waterloo Biology Series 33*: 45, 1990

Mycelium mostly immersed. Conidiophores macronematous, mononematous, single unbranched, erect, straight or slightly flexuous, smooth, 0 or 1 septate, brown, up to 60 µm long x 6-7 µm thick. Conidiogenous cells monoblastic, integrated, terminal, determinate, sometimes percurrent, cylindrical. Conidia solitary, acrogenous, dark brown, paler towards the apex, straight or slightly curved, fusiform or obclavate, apex rounded and surrounded by a mucilaginous sheath, base conico-truncate, verrucose except for the apical cells, (8-) 11-16 euseptate, with dark bands at the septa, 90-175 µm long x 10-13 µm wide in the broadest part, tapering to 3-4 µm near the apex, 6-7 µm at the base.

Specimen examined:
On *Freycinetia* sp.
Palau, Babeldaob, 10.VIII.1991, E.H.C. McKenzie (PDD 60919).

Castañeda & Kendrick (1990) recorded this species on grass from Cuba. The Cuban collections differ slightly in having shorter conidiophores (20-30 µm) and wider conidia (12-17 µm). However, it is a very distinctive species, possess-

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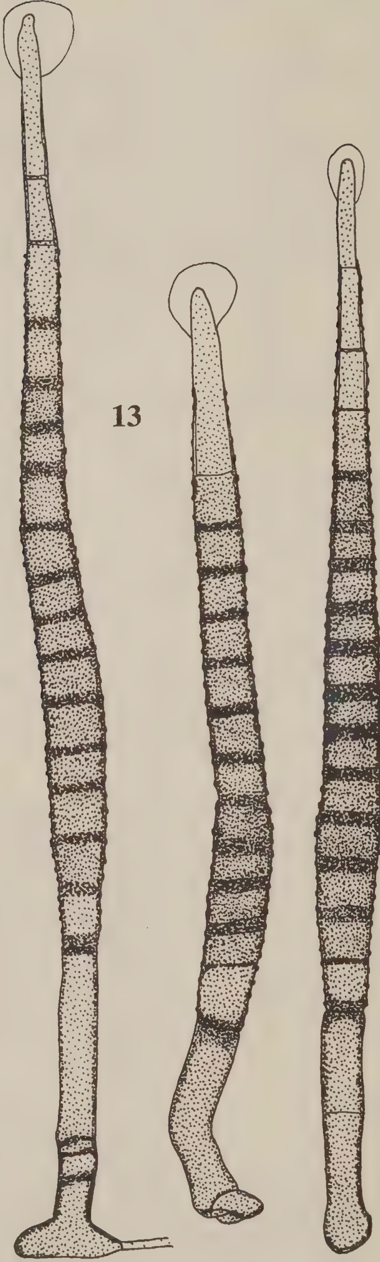

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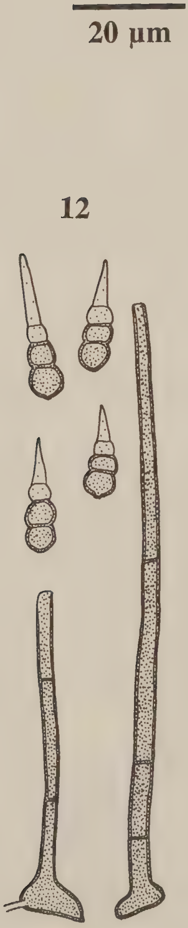

ing verrucose conidia with an apical sheath, and the Palau fungus is obviously conspecific with the Cuban fungus.

Acknowledgement

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Figure 12 *Sporidesmium* sp., conidiophores and conidia (PDD 57493).
Figure 13 *Stanjehughesia decorosa*, conidiophores and conidia (PDD 60919).

MYCOTAXON

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SOME NEW SPECIES AND NEW RECORDS OF DISCOMYCETES IN CHINA. V

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ABSTRACT A new species, *Lanzia phaeoparaphysis* W. Y. Zhuang, is described. Fifteen taxa are reported for the first time from China. Name changes for seven previously recorded Chinese discomycetes are listed.

NEW TAXON

1. **Lanzia phaeoparaphysis** W. Y. Zhuang, **sp. nov.** (Figs. a, b, c)

Ab Lanziae speciebus aliis differt cellulis excipularibus ectalibus refractivis, paraphysibus fuscis, ascis 88 – 98 X 10. 5 – 12. 0 μm, ascosporis subfusoideis, 4 – 6 guttulatis et 18. 0 – 23. 5 X 3. 7 – 5. 0 μm, hymeniis atris, apotheciis 0. 7 mm diam.

Apothecia discoid, stipitate, ca 0. 7 mm in diam, hymenium when fresh dirty orange to somewhat blackish, receptacle light orange to beige, surface smooth. Ectal excipulum of textura prismatica, 40 – 50 μm thick, cells 5 – 20 (– 25) X 3 – 5 μm; cell walls subhyaline, thick, and highly refractive; cells of the outermost layer with brown contents and pale brown walls. Medullary excipulum of textura intricata, 20 – 70 μm thick, hyphal walls subhyaline and refractive. Subhymenium not distinguishable. Hymenium ca 115 μm thick. Asci clavate, 8 – spored, J + in Melzer's reagent, as two short blue lines, 88 – 98 X 10. 5 – 12. 0 μm. Ascospores subfusoid, with one end slightly narrower and one side flat, usually biseriate, with 4 – 6 large guttules and a few small ones, 18 – 23. 5 X 3. 7 – 5. 0 μm. Paraphyses subcylindrical, 2. 5 μm wide, with dark brown contents. No pigmentation exuding from tissues in 2% aqueous KOH solution.

Holotype: on rotten ? petiole, Jiaohe, Jilin, alt. 430 m, X. – q. Zhang & W. – y. Zhuang (735), 27. VIII. 1991, HMAS 61867.

Notes: This species is distinguished from other species of *Lanzia* (Dennis, 1956 ; Dumont, 1975a, b; Dumont & Batra, 1978; Dumont & Pal, 1978; Svrcek, 1982 ; Sharma & Thind, 1983; Gautam & Pant, 1984; Raitviir, Thind & Sharma, 1985 ; Sharma & Sharma, 1985; Krieglsteiner & Baral, 1986; Sharma & Sharma, 1987 ; Spooner, 1987; Zhuang, 1994) in the combination of the following characteristics : apothecia are less than 1 mm in diam, hymenium dirty orange to blackish , ectal excipular cells hightly refractive and thick – walled, asci 88 – 98 X 10. 5 – 12. 0 μm, and ascospores 18. 0 – 23. 5 X 3. 7 – 5. 0 μm. The closest species is *Lanzia huangshanica* W. Y. Zhuang & Korf which has a dark red hymenium, curved paraphyses , wide ectal excipular cells and thick medullary excipulum (Zhuang, 1994) .

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* Partially supported by the National Natural Science Foundation of China.

2. **Aleurina americana** W. Y. Zhuang & Korf, Mycotaxon 26: 366, 1986. (Fig. d)

Diagnostic features: Apothecia broadly attached to the substrate, with pale yellowish subiculum at base, 5 – 7 mm in diam. Ectal excipulum of textura angularis, 75 – 230 μm thick, margin not obviously extending beyond the hymenium, cells 12 – 69 (– 75) X 12 – 59 μm, pustules low and distributed only at margin. Hairs hyaline to subhyaline, 3 – 6 μm wide. Medullary excipulum of textura intricata, 125 – 150 μm thick at flanks. Subhymenium not clearly distinguished. Hymenium ca 300 μm thick. Asci 12 – 15 μm wide. Ascospores 16 – 19 X 9 – 10 (– 11) μm. Paraphyses 4 – 5 μm wide.

Specimen examined: on rotten wood, Jiaohe, Jilin, W. – y. Zhuang (788), 31. VIII. 1991, HMAS 61300.

Notes: Compared with the American collection of *Aleurina americana*(Zhuang & Korf, 1986) the Chinese fungus has somewhat smaller ascospores and is on a different substrate.

3. **Chloroscypha seaveri** Seaver, Mycologia 23: 249, 1931.

Diagnostic features: Apothecia 0. 3 – 0. 6 mm in diam when rehydrated and black when dry. Epithecium present, ca 2 – 7 – 13 μm thick. Ectal excipulum at margin with parallel – arranged hyphae, 40 – 50 μm thick, hyphal walls yellowish olive ; at flanks of textura prismatica to textura angularis, ca 50 μm thick, walls pale yellow; stipe of textura angularis, walls brown; tissues gelatinized or immersed in gel. Medullary excipulum of textura intricata, very thin. Hymenium ca 140 – 150 μm thick. Asci J – in Melzer's reagent with or without KOH pretreatment, 100 – 142 X 20 – 25 μm. Ascospores subfusoid, sometimes with one end broader, multiguttulate 23 – 33 X 8 – 12 μm. Paraphyses straight or curved at apex, 1. 5 – 2. 0 μm wide.

Specimen examined: on needles of *Cryptomeria japonica* Don., Yuexi County, Anhui Province, C. – l. Hou, IV. 1992, HMAS 62987.

Notes: The ascospores of the fungus may finally become brown – walled.

4. **Ciboria** cfr. **betulae** (Woron.) White, Lloydia 4: 171, 1941. (Fig. k)

Diagnostic features: Apothecia 3 – 5 mm in diam, hymenium dirty orange to ocharaceous, receptacle surface smooth, stipe length 4 to 5 times of the disc diam and dark at base. Ectal excipulum of textura angularis to textura globulosa, cells 5 – 18 μm in diam, walls hyaline and thin. Hymenium 105 – 110 μm thick. Asci 8 – spored, J + in Melzer's reagent, pore walls faintly blue, with 2 basal dots darker, 94 – 101 X 7. 7 – 9. 0 μm. Ascospores uniseriate, ellipsoid with one end slightly wider, producing a germ tube or microconidium at one end, 7 – 9 X 3. 7 – 4. 5 μm. Paraphyses 2 – 3 μm wide.

Specimen examined: on rotten leaves of *Betula* sp., Yiershi, Inner Mongolia, alt. 1100 m, W. – y. Zhuang (565), 1. VIII. 1991, HMAS 61869.

Notes: Compared with typical material (Dennis, 1956) the asci and ascospores of the Chinese collection are shorter and the substrates not on fruit but on leaves of *Betula.*

5. **Ciboria bolaris** (Batsch) Fuckel, Jahrb. Nassauischen Vereins Naturk. 23 – 24: 311, 1870. (Figs. e, f)

Diagnostic features: Apothecia discoid, 2 – 4 mm in diam, hymenium light grayish beige (dark brown when dry), receptacle brown (chestnut brown whendry), stipe short. Ectal excipulum of textura angularis to textura globulosa with very small brown pustules on receptacle surface, 23 – 48 μm thick, cells 6 – 14 μm in diam, walls light brown in outer layers and subhyaline in inner layers. Medullary excipulum of textura intricata, 38 – 200 μm thick, hyphae 2 – 3 – 4 μm wide, walls hyaline, subhyaline near subhymenium. Subhymenium 25 – 50 μm thick. Hymenium ca 190 μm thick. Asci J+ in Melzer's reagent, pore walls strongly blue, ca 125 – 130 X 7.5 – 9.0 (– 11.0) μm. Ascospores uniseriate, ellipsoid to elongate – ellipsoid, 11 – 16 X 4.5 – 5.8 μm, becoming dark brown and 3 – septate after discharge. Paraphyses 1.5 – 2.2 μm wide.

Specimen examined: on hard wood of decorticated ? *Quercus* stem, Fuping, Shaanxi, alt. 1300 m, W.-y. Zhuang (894), 26. IX. 1991, HMAS 61870.

Notes: The Chinese collection differs from the typical material (White, 1941) in thinner hymenium, longer and much narrow asci and shorter ascospores. Spores become brown and 3 – septate after discharge. White (1941) recorded that ascospores finally became 2 – 4 celled, but did not mention the color of them.

6. **Hyaloscypha albohyalina** (P. Karst.) Boud., Hist. Classif. Discom. Eur. p. 127, 1907.

Diagnostic features: Apothecia cupulate, sessile, 0.1 – 0.25 mm in diam when dry, pure white. Excipulum of textura prismatica, cells 5 – 15 X (2 –) 7 – 8 μm. Hairs tapered towards the apex, ca 20 – 32 X 4 μm. Asci 8 – spored, J+ in Melzer's reagent, 33 – 36 X 6.0 – 9.0 μm. Ascospores irregularly uniseriate to irregularly biseriate, ellipsoid to elongate – ellipsoid, with small polar guttules, 6 – 9 X 2.0 – 2.5 μm. Paraphyses 1.0 – 1.5 μm.

Specimen examined: on wood, Lijiang, Yunnan, alt. 3170 – 3270 m, R. P. Korf, L.-s. Wang & W.-y. Zhuang (353), 2. XI. 1988, HMAS 61871.

7. **Hyaloscypha aureliella** (Nyl.) Huhtinen, Karstenia 29: 107, 1990.

Diagnostic features: Apothecia cupulate, sessile, hairy, 0.75 mm in diam, pure white when fresh and beige when dry. Excipulum of textura prismatica, cells 6 – 15 X 4 – 8 μm. Hairs tapered towards the apex, ca 27 – 43 X 3 – 4 μm. Asci 8 – spored, J+ in Melzer's reagent, 33 – 47 X 5.0 – 6.5 μm. Ascospores irregularly biseriate, ellipsoid to elongate – ellipsoid, 5 – 7 X 2.2 X 2.5 μm.

Specimen examined: on wood, Lijiang, Yunnan, alt. 3170 – 3270 m, R. P. Korf, L.-s. Wang & W.-y. Zhuang (357), XI. 1988, HMAS 61872.

8. **Hymenoscyphus caudatus** (P. Karst.) Dennis, Persoonia 3: 76, 1964.

Diagnostic features: Apothecia discoid, 0.2 – 1.0 mm in diam, hymenium yellow, light yellow to whitish, stipe light brown to brown at base. Ectal excipulum of textura prismatica. Medullary excipulum of textura intricata. Hymenium 87 – 100 μm. Asci 8 – spored, J+ in Melzer's reagent, 70 – 112 X 7.5 – 10.0 μm. Ascospores biseriate to irregularly biseriate, one end wider and one end pointed, one side slightly bent, 14 – 19 X 3.5 – 5.0 μm. Paraphyses subcylindrical, 2.5 – 3.5 μm at apex.

Specimens examined: on leaf, Liuba, Shaanxi, alt. 950 m, W.-y. Zhuang (840), 21. IX. 1991, HMAS 61873; on leaf veins, Liuba, Shaanxi, alt. 950 m, W.-y. Zhuang (850), 21. IX. 1991, HMAS 61874; on blackened leaf veins, Liuba, Shaanxi, alt. 950 m, W.-y. Zhuang (852), 21. IX. 1991, HMAS 61875; on herbaceous plant parts, Fuping, Shaanxi, alt. 1300 M, W.-y. Zhuang (887), 26. IX. 1991, HMAS 61876.

Notes: '*Hymenoscyphus* cfr. *caudatus* (P. Karst.) Dennis sensu Dumont &

S.E. Carp." was recorded formerly by Zhuang & Korf (1989). The collections from Shaanxi agree with the typical material.

9. **Hymenoscyphus phyllogenon** (Rehm) Kuntze, Rev. Gen. Pl. 3: 485, 1898.

Diagnostic features: Apothecia 0.6-1.5 mm in diam, stipitate, hymenium light yellow to white, dark at stipe base. Ectal excipulum of textura angularis, 38-75 μm thick, cells 5-10 X 7-20 μm, covering layer 2-3 hyphal layers. Medullary excipulum of textura intricata, 180-200 μm thick at flanks, hyphae 2-6 μm wide. Subhymenium 20 μm thick. Hymenium 90-93 μm thick. Asci 8-spored, J + in Melzer's reagent, 76-89 X 7.0-8.8 μm. Ascospores uniseriate, subfusoid. 8.5-12.0 X 4.0-5.0 μm. Paraphyses filiform, 3.0-3.5 μm wide.

Specimens examined: on leaf veins, Huangshan, Anhui, alt. 1300-1700 m, Y.-r. Lin, S.-m. Yu, W.-j. Wu, Y. Wang & W.-y. Zhuang (1127), 27. IX. 1993, HMAS 61877; on leaf veins, Huangshan, Anhui, alt. 1300-1700 m, Y.-r. Lin, S.-m. Yu, W.-j. Wu, Y. Wang & W.-y. Zhuang (1128), 27. IX. 1993, HMAS 61878.

Notes: This species was commonly reported on leaves of *Populus* and *Quercus* (White, 1943; Dennis, 1956). The host of the Huangshan collections is scarcely recognizable.

10. **Hymenoscyphus scutulus** (Pers.) W. Phillips, Brit. Discom. p. 136, 1887.

Diagnostic features: Apothecia 0.5-1.6 (-2.4) mm in diam, hymenium yellow, dirty yellow, beige, to light brown, stipe light brown to beige, darker at bese. Ectal excipulum of textura prismatica, 40-55 μm thick, cells 7-25 X 5-11 μm. Medullary excipulum of textura intricata, 45-160 μm thick. Hymenium 110-130 μm thick. Asci 8-spored, J + in Melzer's reagent, 87-120 X 9.0-10.0 μm. Ascospores biseriate, 2-4-6 guttules, 17-25 X 3.5-4.5 μm, with 1-2 cilia at the pointed end and 0-1 cilium at rounded end. Paraphyses filiform, 2-3 μm wide.

Specimens examined: on herbaceous stem, Bailang, Inner Mongolia, alt. 1350 m, W.-y. Zhuang (679), 18. VIII. 1991, HMAS 61879; on herbaceous stem, Bailang, Inner Mongolia, alt. 1350 m, W.-y. Zhuang (681), 18. VIII. 1991, HMAS 61880; on herbaceous stems, Tewo, Gansu, alt. 2600 m, W.-y. Zhuang (1018), 11. IX. 1992, HNAS 61881; on herbaceous stem, Huangshan, Anhui, alt. 1300-1700 m, Y.-r. Lin, S.-m. Yu, W.-j. Wu, Y. Wang & W.-y. Zhuang (1119), 27. IX. 1991, HMAS 61882.

11. **Hymenoscyphus scutulus** (Pers. : Fr.) W. Phillips var. **fucatus** W. Phillips, Brit. Discom. p. 137, 1887. (Fig. 1)

Diagnostic features: Apothecia 1.0-1.6 mm in diam, stipitate, hymenium dirty yellow, stipe base dark. Ectal excipulum of textura prismataca, cells 7 μm wide, walls somewhat glassy and thickened. Medullary excipulum of textura intricata, hyphae 2-3 μm wide and thin-walled. Asci 8-spored, J + in Melzer's reagent, pore walls strongly blue. 97-120 X 14.0-14.5 μm. Ascospores biseriate to irregularly biseriate, with one end pointed and one rounded, usually 3 cilia formed on the pointed end and 2 on rounded end, with 4-6 guttules, 23.5-27.0 X 5.0-6.3 μm. Paraphyses very slightly enlarged at apex, 3.0-4.5 μm wide at the widest portion.

Specimen examined: on herbaceous stem, Tewo, Gansu, alt. 2600 m, W.-y. Zhuang (1017), 11. IX. 1992, HMAS 61883.

Notes: White (1944) provided a very detailed description and illustrations of this fungus. The apothecia of the Chinese collection have a dark stipe base, it could be a member of the genus *Lanzia.*

12. **Lambertella himalayensis** V. P. Tewari & D. C. Pant, Mycologia 59: 117, 1967. (Fig. g)

Diagnostic features: Apothecia discoid, 2 mm in diam, hymenium dirty yellow when fresh and brownish when dry, stipes not long, dark at base. Ectal excipulum of textura prismatica to textura angularis, 50 - 75 μm thick, outer surface with short, irregular hyphal protrusions. Medullary excipulum of textura intricata, 60 - 360 μm thick, hyphae hyaline, thin-walled, 3 - 8 μm wide. Hymenium 100 - 120 μm thick. Asci 2-or 4-spored, J+ in Melzer's reagent, 91 - 110 X 9 - 11 μm. Ascospores uniseriate, fusoid to lemon-shaped, 12.7 - 18.0 X 5.5 - 7.7 μm in 4-spored asci and 22 - 24 μm long in 2-spored asci. Paraphyses subcylindrical, 2 - 3 μm wide.

Specimen examined: on ? petioles, Jiaohe, Jilin, alt. 430 m, W. -y. Zhuang (729), 27. VIII. 1991, HMAS 61884.

Notes: The collection seems abnormal or to be parasitized by another fungus. Some asci developed 8 ascospores which never mature. Mature asci contain 2 - 4 spores which are not clearly punctate.

13. **Lambertella** cfr. **korfii** Zhuang, Mycotaxon 39: 480, 1990. (Figs. h, i)

Diagnostic features: Apothecia flat to discoid, 1.0 - 1.5 mm in diam, hymenium olivaceous, receptacle olivaceous, darker near stipe, stipe dark brown at base. Ectal excipulum of loose textura prismatica, 35 - 66 μm thick, cells 18 - 36 X 7 - 20 μm, walls glassy and somewhat thickened, covering layer 1 cell thick, with short and narrow protrusions 13 - 33 X 2.0 - 3.5 μm. Medullary excipulum of textura intricata, 26 - 200 μm thick from margin to base, hyphae hyaline, thin-walled, 5 - 17 μm wide. Subhymenium 13 - 20 μm thick. Hymenium ca 90 μm thick. Asci 8-spored, J+ in Melzer's reagent, 71 - 86 X 6.5 - 7.5 μm. Ascospores uniseriate to irregularly uniseriate, ellipsoid with one end slightly narrower, with 2 large guttules, hyaline within asci and brown after discharge, 8.0 - 8.5 X 3.5 - 3.8 μm (hyaline), 9.0 - 11.3 X 5.0 - 5.7 μm (brown). Paraphyses 2 - 3 μm thick.

Specimen examined: on stromatized fallen leaves, Tewo, Gansu, alt. 2600 m, W. -y. Zhuang (1016), 11. IX. 1992, HMAS 61885.

Notes: The Gansu specimen is different from the typical material (Zhuang, 1990) in smaller asci (71 - 86 X 6.5 - 7.5 μm vs. 78 - 95 X 6.7 - 9.0 μm) and ascospores (8.8 - 11.3 X 3.5 - 5.7 μm vs. 10.0 - 13.5 X 4 - 6 μm).

14. **Lambertella** near **tewari** Dumont, Mem. NY Bot. Gard. 22 (1): 146, 1971. (Fig. m)

Diagnostic features: Apothecia 1.0 - 2.5 mm in diam, hymenium dirty yellow. Ectal excipulum of textura prismatica, 40 - 50 μm thick, cells 8 - 15 X 17 - 38 μm, containing only 3 cell layers; outer covering layer of 2 hyphal layers, hyphae 4 - 6 μm wide. Medullary excipulum of textura intricata, 40 - 350 μm thick, hyphae 4 - 10 μm wide. Subhymenium poorly developed, ca 15 - 20 μm thick. Hymenium 107 - 115 μm thick. Asci 8-spored, J+ in Melzer's reagent, 100 - 110 X 7 - 9 μm. Ascospores hyaline and subfusoid when young, becoming light brown and elongate-ellipsoid after discharge, biguttulate, 9.0 - 13.5 X 3.5 - 4.3 μm.

Specimen examined: on leaf, Huangshan, Anhui, alt. 800 – 1000 m, Y. – r. Lin, S. – m. Yu, W. – j. Wu, Y. Wang & W. – y. Zhuang (1076), 26. IX. 1993, HMAS 61886.

Notes: The Huangshan collection differs from the typical material (Dumont, 1971) in lack of hyphal scales on receptacle and stipe surface, larger ascospores and light brown mature spores.

15. **Ramsbottomia crechqueraltii** (P. Crouan) Benkert & T. Schumach., Agarica 6 (12): 33, 1985.

Diagnostic features: Apothecia turbinate, 0. 7 – 1. 2 mm in diam, hymenium dirty orange. Ectal excipulum of textura angularis, 70 – 150 μm thick, margin with elongate hyphoid cells possessing enlarged ends, cells at flanks more or less isodiametric, up to 33 μm in diam, or ellipsoid, up to 50 X 30 μm, walls hyaline. Medullary excipulum hardly distinguishable. Hymenium 270 – 280 μm thick. Asci 17 – 21 μm wide. Ascospores mostly spherical, with spines on surface, 15 – 17 μm in diam, spines 0. 7 – 1. 0 μm wide and 1. 5 – 3. 1 μm long. Paraphyses slightly enlarged at apex, 6. 0 – 7. 5 μm at apex and 4. 0 – 4. 5 μm below.

Specimen examined: on wet soil, Jiaohe, Jilin, W. – y. Zhuang (776), 29. VIII. 1991, HMAS 61304.

Notes: Apothecia of the Jilin collection are smaller than the typical (2 – 5 mm in diam according to Benkert & Schumacher, 1985), as well as the ascospores (15 – 17 μm in diam vs. 15 – 21 X 13 – 17 μm).

16. **Wynnea americana** Thaxt., Bot. Gaz. 39: 246, 1905.

Diagnostic features: Apothecia auriculate, 45 – 120 X 35 – 70 mm, several growing on a common stalk, hymenium vinaceous brown to light vinaceous, receptacle very dark brown. Ectal excipulum of textura angularis, 64 – 90 μm thick excluding pustules, outermost cells nearly spherical, walls light brown; pustules small, distributed mostly on lower flanks. Medullary excipulum of textura intricata, 300 – 530 μm thick or more, hyphae 7 – 13 μm wide, walls subhyaline. Subhymenium of textura densely intricata, 100 μm thick. Hymenium ca 390 μm thick. Asci ca 19 μm wide. Ascospores apiculate, bilaterally asymetrical, 35. 5 – 43 X 16. 0 – 12. 5 μm. Paraphyses branched at different levels, somewhat deformed at apex.

Specimen examined: on soil, Jiaohe, Jilin, F. – y. Bai & J. – b. Chen (WYZ 783), 29. VIII. 1991, HMAS 60669.

Notes: Ascospores of the Chinese fungus are slightly larger than those of the American one (Pfister, 1979).

SPECIES PREVIOUSLY REPORTED FROM CHINA FOR WHICH DIFFERENT NAMES ARE REQUIRED

17. **Chlorociboria aeruginascens** (Nyl.) Kanouse ex Ramsnurthi & al., Mycologia 49: 858, 1958.

Notes : This name is for the previously ecorded *Chlorosplenium aeruginascens* (Nyl.) P. Karst. (Dixon, 1975; Tai, 1979).

18. **Chlorociboria aeruginosa** (Per. : Fr.) Seaver ex Ramsnurthi & al., Mycologia 49: 859, 1958.

Notes: This is the correect name for *Chlorosplenium aeruginosum* (Pers. : Fr.) De Not. (Dixon, 1975) which was erroneously recorded as *Chlorosplenium aeruginosum* (Oeder.) De Not. (Tai, 1979).

19. **Ciboria batschiana** (Zopf) N. F. Buchw., Friesia 3: 255, 1947. (Fig. j)

Specimens examined: on stromatized *Quercus* acorns, Fuping, Shaanxi, alt. 1300 m, X. -q. Zhang & W. -y. Zhuang (885), 26. IX. 1991, HMAS 61887; on stromatized *Quercus* acorns, Fuping, Shaanxi, alt. 1300 m, W. -y. Zhuang (886), 26. IX. 1991, HMAS 61888; on ? duff, Tewo, Gansu, alt 2300 m, W. -y. Zhuang (1031), 12. IX. 1992, HMAS 61891; on stromatized *Quercus* acorn, Tewo, Gansu, W. -y. Zhuang (1032) 12. IX. 1992, HMAS 61892; on seeds, Huangshan, Anhui, alt. 500 m, Y. -r. Lin (WYZ 1165), 29. IX. 1993, HMAS 61893.

Notes: This name was used in China and is commonly accepted for *Ciboria pseudotuberosa* (Rehm) Rehm (Teng, 1963; Tai, 1979; Kohn, 1979; Palmer, 1990). The excipular tissues of the Chinese collections become blue in Melzer's reagent.

20. **Helvella chinensis** (Velen.) Nannf. & L. Holm in Lundell, Nannfeldt & Holm, Publs. Herb. Univ. Uppsala 18: 5, 1985 (1984).

Notes: Lundell et al. (October, 1985) indicated that *Helvella chinensis* is the correct name for *H. villosa* (Hedw.) Dissing & Nannf. *H. sinensis* B. Liu & J. Z. Cao was later established (Liu et al., November, 1985). According to the International Code of Botanical Nomenclature, *H. chinensis* and *H. sinensis* are homonyms. The latter is not validly published.

21. **Hymenoscyphus epiphyllus** (Pers. : Fr.) Rehm in Kauffm. Papers Mich. Acad. 9: 117, 1929 (1928).

Specimen examined: on fallen leaves of *Betula* sp., Sangduer, Aershan, Inner Mongolia, alt. 1210 m, W. -y. Zhuang (622), 14. VIII. 1991, HMAS 61894.

Notes: This is for the formerly recorded *Helotium epiphyllum* (Pers.) Fr. (Tai, 1979).

22. **Hymenoscyphus scutulus** (Pers. : Fr.) W. Phillips var. **solani** S. Ahmad, Biol. Soc. Pakistan Monograph No. 7, p. 207, 1978.

Notes: When Korf & Zhuang (1985) made the combination "*Hymenoscyphus* scutulus Pers. : Fr.) Phill. var. *solani* Korf & Zhuang" they did not notice that Ahmad (1978) had already published the combination.

23. **Jafnea fusicarpa** (W. R. Gerard) Korf, Nagaoa 7: 5, 1960.

Notes: *Helvella fusicarpa* (W. R. Gerard) E. J. Durand was previously recorded (Tai, 1979). *Jafnea* is the correct generic name for the species (Korf, 1960).

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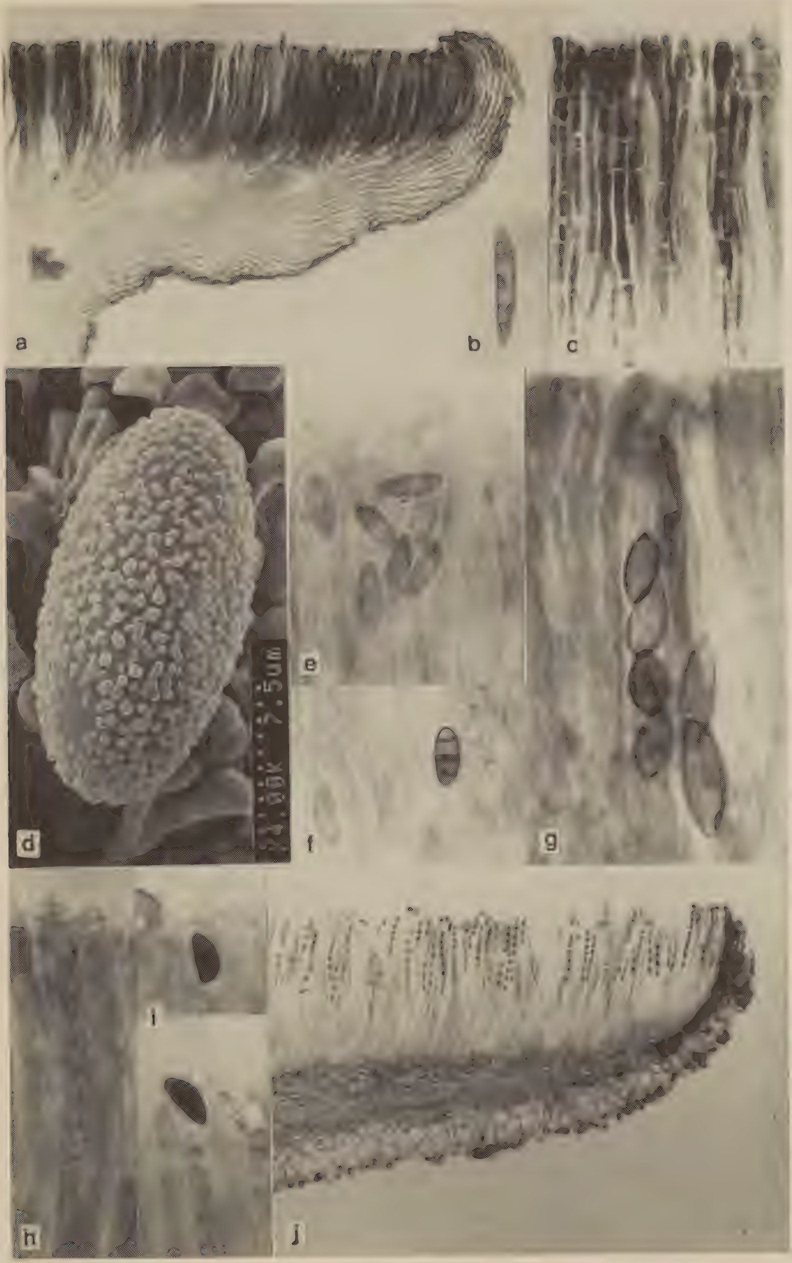
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中国盘菌新种和新记录 V

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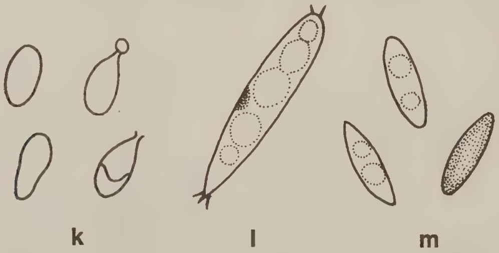
摘要: 本文描述暗侧丝兰斯盘菌为新种, 报道15个中国盘菌新记录种, 并对7个以前报道的盘菌名称做了命名上的更正。

Figs. **a – j.** **a – c** *Lanzia phaeoparaphysis* (from holotype): **a.** apothecial structure, X 145; **b.** an ascospore, X 730; **c.** dark paraphyses in water mount, X 730; **d.** *Aleurina americana* (from HMAS 61300): SEM of an ascospore; **e – f** *Ciboria* cfr. *bolaris* (from HMAS 61870): **e.** ascospores, X 730; **f.** a discharged ascospore with 3 septa and brown wall, X 730; **g.** *Lambertella himalayensis* (from HMAS 61884): portion of 4 – spored and 2 – spored asci, X 730; **h – j** *Lambertella* cfr. *korfii* (from HMAS 61885): **h.** hyaline ascospores within ascus, X 730; **i.** two dark brown ascospores after discharge, X 730; **j.** *Ciboria batschiana* (from HMAS 61888): apothecial structure, X 145.



Figs. **k – m.** **k.** *Ciboria* cfr. *betulae* (from HMAS 61869): ascospores and spore germination, X 1010; **l.** *Hymenoscyphus scutulus* var. *fucatus* (from HMAS 61883): an ascospore, X 1170; **m.** *Lambertella* near *tewari* (from HMAS 61886: ascospores (from lift to right: subfusoid and hyaline young spore, subhyaline mature spore, light brown and fully mature spore), X 1060.

MYCOTAXON

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A NEW SPECIES OF LAMBERTELLA WITH PECULIAR ASCOSPORES

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In my examinations of several collections related to the Sclerotiniaceae, an interesting fungus was encountered. The apothecial anatomy and presence of light brown ascospores indicated that it might be a member in the genus *Lambertella* Hoehn. But a substratal stroma was not found and the spores are scutuloid with a refractive collar at the narrow end. *Lambertellinia* Korf & Lizon (1994) which has scutuloid and brown ascospores is another possibility, but the excipular structure is different. It is also similar to *Hymenoscyphus* Gray structurally but the presence of light brown ascospores does not fit, and such spore appendage are unknown there, too.

Morphologically, the closest species appears to be *Hymenoscyphus scutulus* (Pers. : Fr.) W. Phillips var. *fucatus* W. Phillips for which White (1944) provided a detailed description and beautiful illustrations. The Huangshan collection is different from *H. scutulus* var. *fucatus* in much smaller and beige-colored apothecia, wider asci, larger and light brown ascospores, and the presence of a refractive collar at narrow end of the spore instead of short cilia.

The spore characteristics of the Huangshan fungus are peculiar for any of the above mentioned genera. Where to place the fungus? To avoid establishing a new genus, one of them has to be chosen to accommodate this species. Although its structure and some characters resemble *Hymenoscyphus scutulus* var. *fucatus* except for spores, I prefer not to put this species in *Hymenoscyphus* since it is a genus containing diverse species which may not be closely related and has no clear generic concept. Deep thought has been given to its fitness to *Lambertellinia* because of the spore shape and color. Nevertheless, a substratal stroma is not clear and the ectal excipulum is not of textura porrecta. *Lambertella* is the last choice. In the genus *Lambertella*, *L. albida* (Rabenh.) Korf possesses somewhat scutuloid ascospores (White, 1944), but the spores are much smaller [(13-17 X 3-5 μm by Dennis (1956) vs. 33-43 X 7.0-11.0 μm] than the Huangshan collection and a refractive collar was never recorded. I tentatively place it in *Lambertella* and described it as *Lambertella torquata.*

Lambertella torquata W.Y. Zhuang, **sp. nov.** (Fig. 1)

Ab Lambertella albida ascosporis peramplis cum colloris refractivis differt. Ab Hymenoscypho scutulo ascosporis brunneis cum collaris refractivis differt.

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Apothecia discoid, beige to light brown when fresh, 0.6-0.9 mm in diam, 0.7-2.0 mm high, stipes 0.5-1.5 mm long and hairy at lower portion, recetacle slightly lighter than hymenium; when dry hymenium black, receptacle dark brown, somewhat darker at very base. Ectal excipulum of textura prismatica, 25-43 μm thick, cell walls subhyaline, outer covering layer of 2-3 hyphal layers, hyphae 2.5-4.0 μm wide, walls pale brown. Medullary excipulum of textura intricata, of textura porrecta near ectal excipulum, 38-102 μm thick, hyphae subhyaline. Hymenium 165-170 um thick. Asci clavate, J+ in Melzer's reagent, pore walls strongly blue, apex conical with a rounded end, 8-spored, 130-145 X 16.5-17.8(-20) μm. Ascospores irregularly biseriate, apical end rounded and slightly curved, basal end more or less pointed and with a hyaline, refractive, infundibuliform collar which stains in cotton blue, spores usually hyaline within asci and when discharge becoming light brown and 3-septate, very few asci bearing light brown spores, hyaline spores 33-43 X 7.0-8.5 μm, light brown spores 36-41 X 7.6-11.0 μm. Paraphyses faintly enlarged at apex, 2-3 μm wide at apex, with light brown contents.

Holotype: on herbaceous stem, between Hot Spring and Taoyuanting, Huangshan, Anhui Province, alt. 630 m, Y.-r.Lin, S.-m.Yu, B.Deng, H.-y.Xing, W.-b.Li & B.-x. Liu, XI.6.1994, HMAS 68286.

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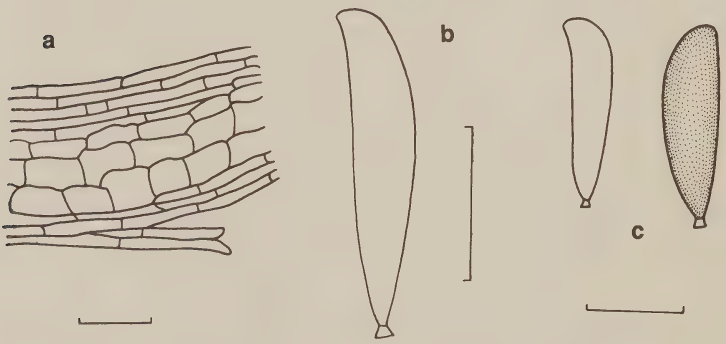

Fig.1 *Lambertella torquata:* a. structure of ectal excipulum; b. an ascospore; c. hyaline and brown ascospores. All from holotype. Bar = 20 μm.

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THE SAXICOLOUS SPECIES OF THE GENUS *RINODINA* IN THE IBERIAN PENINSULA CONTAINING ATRANORIN, PANNARIN OR GYROPHORIC ACID

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ABSTRACT: The morphology, anatomy, ecology and distribution of twelve Iberian saxicolous *Rinodina* species containing atranorin, pannarin or gyrophoric acid are discussed, namely *Rinodina alba, R. aspersa, R. atrocinerea, R. beccariana, R. canariensis, R. confragosa, R. luridescens, R. occulta, R. oxydata*, *R. santorinensis, R. trachytica* and *R. vezdae*. Several other secondary lichen compounds are recorded for the first time from the genus. New data on the chemistry of *R. alba, R. aspersa, R. atrocinerea* and *R. trachytica,* are provided. *R. attica* is reduced to synonymy with *R. occulta* and *R. aspersa* is reported for the first time in the study area. Some illustrations and a key to the species are provided.

INTRODUCTION

The species treated in this paper are characterized by the presence of particular secondary lichen compounds which can be detected after the application of reagents (spot tests): **atranorin** (with chloratranorin), **gyrophoric** acid (usually accompanied by traces of lecanoric and orsellinic acids, see SCHREINER & HAFELLNER 1992: 22) and **pannarin**. Atranorin reacts K+ yellow, and it is present in all species considered except *R. luridescens*. Gyrophoric acid reacts C+ red and it is present in *R. alba, R. aspersa, R. atrocinerea, R. canariensis* and *R. luridescens*, while pannarin reacts PD+ orange and it is present only in *R. santorinensis*. All these reactions are strong and visible under the stereomicroscope.

As these lichen substances are presented as crystals, they are also easily observed under polarizing light. They are particularly concentrated in the cortical and medullary tissues of the thallus and in the thalline margin, both of which appear entirely interspersed with crystals. Gyrophoric acid and pannarin can be also present in the epihymenium and in the proper margin. Atranorin crystals dissolve in K giving, a yellow coloration; gyrophoric acid crystals dissolve in C, giving a reddish coloration and pannarin crystals dissolve in PD, forming orange acicular crystals.

Other secondary lichen compounds present in the species treated in this paper (e.g. zeorin, 2'-*0*-methylperlatolic and confluentic acids) do not give spot test reactions and must be detected by TLC.

The following lichen compounds have been detected for the first time in the genus *Rinodina:* umbilicaric and ovoic acids are biosynthetically related to gyrophoric acid and present in *Rinodina aspersa* and *R. atrocinerea*; 2'-*0*-methylsuperlatolic and 2'-*0*-methylisohyperlatolic/2'-*0*-methylhyperlatolic acids are related to 2'-*0*-methylperlatolic acid, and hyperconfluentic acid is related to confluentic acid, all of which are present in *R. trachytica*. Furthermore, a new depside related to gyrophoric acid has been detected in all specimens of *R. alba* analysed by TLC. According to ELIX (in litt.) that substance could be 2''-*0*-methylgyrophoric acid, a still undescribed isomer of umbilicaric and ovoic acids (this has not yet been confirmed).

The ascospores of the species considered belong to four different types: the *Physconia*-type (including *Milvina*-type), in *R. luridescens*; the *Physcia*-type in *R. confragosa* and *R. occulta*; the *Mischoblastia*-type in *R. oxydata, R. trachytica* and *R. vezdae* and the *Pachysporaria*-type in the other species treated. Among these species, *R. alba, R. aspersa* and *R. atrocinerea* possess typical *Pachysporaria*-type ascospores while *R. beccariana, R. canariensis* and *R. santorinensis* have *Pachysporaria*-type ascospores showing tendencies towards the *Physcia*-type (compare fig. 1A-B with 1C). These were termed by MAYRHOFER et al. (1993) and MATZER et al. (1994) as being "similar to the *Pachysporaria*-type".

Mature *Pachysporaria*- (including the "similar to *Pachysporaria*-type") and *Mischoblastia*-type ascospores are rather similar in appearance but they should not be confused if their ontogeny is carefully studied. Clear differences are obvious in the medium stages, since the lumina never become extremely angular in the *Pachysporaria*-type as occurs in the *Mischoblastia*-type (compare figs. 1A-B and 4A-C).

All the present species have ascospores which originate via a type A ontogeny: in young ascospores, the septum is inserted before internal wall-thickenings (see GIRALT 1994; GIRALT & MAYRHOFER 1995).

The asci are of typical *Lecanora*-type (sensu HONEGGER 1978) in *Rinodina alba, R. atrocinerea, R. beccariana, R. canariensis, R. confragosa, R. luridescens, R. occulta* and *R. santorinensis* and *R. trachytica* but often show tendencies towards the *Bacidia*-type in *R. oxydata* (RAMBOLD et al. 1994) and *R. vezdae*.

Finally, the apothecia are pseudolecanorine from the beginning (DUGHY 1952, CLAUZADE & ROUX 1985, GIRALT 1994) in *R. luridescens*; lecanorine but usually becoming pseudolecanorine in *R. beccariana* var. *lavicola, R. occulta* and *R. oxydata* and cryptolecanorine (SHEARD 1967) in *R. trachytica,* rather than typically lecanorine as occurs in the other species considered.

Although the present paper is devoted to species which occur in the Iberian Peninsula, new chorologic data from the Balearic and Canary islands and from North Africa are also mentioned.

MATERIAL AND METHODS

All descriptions are based on our personal examinations. Current mycological terminology has been employed and generally follows that of HAWKSWORTH et al. (1983). The terminology for the asci follows that of HONEGGER (1978) and RAMBOLD et al. (1994) while for the ascospore-types the terminolgy of MAYRHOFER (1982), SCHEIDEGGER (1993), GIRALT (1994) and GIRALT & MAYRHOFER (1995) is followed. The standardized methods of thin layer chromatography (TLC) were employed (e.g. CULBERSON & AMMANN 1979; CULBERSON et al. 1981; CULBERSON & JOHNSON 1982) for the identification of lichen substances.

As most of the species considered have previously been described in detail in other revisional treatments, including those of SHEARD (1967), MAYRHOFER & POELT (1979), MAYRHOFER (1984), FOX & PURVIS (1992), MAYRHOFER et al. (1993) and MATZER et al. (1994), the descriptions given here simply emphasize characters of value for species identification and do not repeat features common to all species.

KEY TO THE SPECIES

1 Thallus K- (atranorin absent), C+ faintly red (gyrophoric acid present). Hypothecium brownish. Ascospores *Physconia*-type, (16-)19-21(-22) x (7,5-)9-11(-12) µm. Apothecia pseudolecanorine from the beginning.
R. luridescens

1* Thallus K+ yellow (atranorin present). Hypothecium colourless. Ascospores not of *Physconia*-type.
2

2 Thallus PD+ orange (pannarin present). Ascospores *Pachysporaria*-type grading into the *Physcia*-type, 14-22 x 7-14 µm.
***R. santorinensis* s.l.**

2* Thallus PD- (pannarin absent).
3

3 Thallus C+ red (gyrophoric/lecanoric acids present).
4

3* Thallus C- (gyrophoric/lecanoric acids absent).
7

4 Thallus sorediate, soralia discrete. Apothecia rare. Ascospores of typical *Pachysporaria*-type, 15-20 x 10-13 µm.
R. aspersa

4* Thallus not sorediate. Apothecia always present.
5

5* Medulla I+ violet (microscopic slide!). Ascospores of typical *Pachysporaria*-type, (11-)13-15(-17) x (7,5-)8-10(-11) µm. Unknown substance present.
R. alba

5* Medulla I-. Ascospores significantly larger. Unknown substance absent.
6

6 Ascospores (13-)16-19(-22) x (8-)9-12(-13) µm, of typical *Pachysporaria*-type, globose-ellipsoid, not curved. Lumina often showing protrusions towards spore-ends. Thallus always autotrophic.
R. atrocinerea

6* Ascospores larger, (16-)19-26(-32) x (8-)9-11(-13) µm, *Pachysporaria*-type grading into the *Physcia*-type, fusiform, usually curved. Lumina never showing protrusions towards spore-ends. Thallus usually parasitic.
R. canariensis

7 Ascospores *Pachysporaria*-type showing tendencies towards the *Physcia*-type, 15-29 x 6-15 µm.
***R. beccariana* s.l.**

7* Ascospores different, of typical *Physcia*- or *Mischoblastia*-type.
8

8. Ascospores *Physcia*-type.
9

8* Ascospores *Mischoblastia*-type.
10

9 Ascospores (16-)18-23(-27) x (7-)8-10(-12) µm. Apothecia lecanorine, 0,5-1,5 mm diam. Thalline margin thick, prominent and persistent.
R. confragosa

9* Ascospores smaller, (10-)13-16(-18) x (5,5-)6-8 µm. Apothecia usually becoming pseudolecanorine, up to 0,3 mm diam. Thalline margin excluded early.
R. occulta

10 Thallus containing 2'-*O*-methylperlatolic acid chemosyndrome. Ascospores (14-)16-19(-23) x (7,5-)8-10(-12) µm.
R. trachytica

10* Thallus lacking 2'-*O*-methylperlatolic acid chemosyndrome. Ascospores significantly larger.
11
(*R. oxydata* coll.)

11 Ascospores (17-)19-23(-26) x (9-)10-12(-13) µm.
R. oxydata

11* Ascospores (21-)24-27(-30) x (10-)12-14(-16) µm.
R. vezdae

THE SPECIES

1. *RINODINA ALBA* Metzler ex Arnold

Metzler ex Arnold 1872: 35.- **type**: France, Hyères, 1867, Metzler (W, WU-isotypes, not seen).

Icon.: Fig. 1A (ascospore-ontogeny); Fig. 2 (chromatogram in solvent systems A, B' and C). Further illustrations: Mayrhofer (1984: 373, fig. 3; distribution); Matzer et al. (1994: 106, fig. 1B; ascospore-ontogeny).

Thallus usually thick and well developed, areolate. Areolae contiguous, angulose, surface smooth to irregular, flat, whitish, rarely grey. Prothallus black, usually present. Spermogonia frequent. Apothecia lecanorine, rarely becoming pseudolecanorine, abundant, scattered to confluent, up to 0,3-0,5(-0,7) mm diam., innate to adnate. Thalline margin thin, entire and usually persistent. Disc brown to black, often slightly pruinose, plane to convex. Epihymenium dark brown, interspersed with small crystals reacting C+ red (gyrophoric acid, microscopic slide!). Hymenium 60-80 µm high. Asci *Lecanora*-type. Ascospores of typical *Pachysporaria*-type, (11-)13-15(-17) x (7,5-)8-10(-11) µm, lumina often showing protrusions towards the spore-ends, torus developed, faintly warted.

CHEMISTRY: Thallus and thalline margin K+ yellow and C+ red, epihymenium C+ red (microscopic slide!); medulla I+ violet (microscopic slide!); atranorin, gyrophoric acid (with ±lecanoric and orsellinic acids), and an unknown substance, by TLC. The unknown substance is characterized by Rf classes 3/3/3 and yellowish colour after visualitation. Those features do not fit with any of the depsides related to the gyrophoric acid and its relatives given in ELIX et al. (1987). It has been detected in all specimens analysed but was not previously reported from *R. alba* (compare LUMBSCH & TITZE 1981; LEUCKERT & MAYRHOFER 1984). According to ELIX (in litt.), it could be 2''-*0*-methylgyrophoric acid, a still undescribed isomer of umbilicaric and ovoic acids (this has not yet been confirmed).

DISCUSSION: *Rinodina alba* is characterized by the invariably well developed, continuous, areolate and whitish thallus, the I+ violet medullary reaction, the small, typical *Pachysporaria*-type ascospores and its chemistry. The closely related species, *R. atrocinerea* and *R. canariensis* are mainly distinguished by the lack of medullary reaction with iodine, the significantly larger ascospores and by the absence of the unknown substance. The yellowish-orange pigment (usually reacting K+ and C+ purple red) located in the lower surface of all thalli of *R. canarinesis* and sometimes also in those of *R. atrocinerea*, has not been observed in *R. alba.* An interesting feature common to *R. alba* and *R. atrocinerea* but absent in *R. canariensis,* is the presence in the ascospores of lumina protrudings towards the spore-ends. Another related species, *R. aspersa,* is mainly separated by its sorediate thallus.

Rinodina luridescens which also contains gyrophoric acid, is distinguished by the lack of atranorin, the darker thallus, pseudolecanorine apothecia, brownish hypothecium and larger *Physconia*-type ascospores.

ECOLOGY AND DISTRIBUTION: *Rinodina alba* is a mainly maritime southern Mediterranean and Macaronesian species. It occurs from the coast up to ca. 600 m, preferently on shaded hard siliceous rocks. According to EGEA (1989) it is characteristic of the Al. *Lecanorion montagnei* Llimona community (EGEA & LLIMONA 1987) and it has frequently been reported from the study area. The record in SANCHEZ-BIEZMA & LÓPEZ DE SILANES (1992) refers to *R. atrocinerea*.

Specimens examined: SPAIN: Andalucía: Almería, Los Lobos, Collado de la Casa Nueva, 115 m, 6.4.1977, J.M. EGEA (MUB-739). Sierra de Gata, Las Salinas del Cabo de Gata, Cerro San Miguel, La Cruceta, ca. 200 m, 11.7.1968 & 21.3.1972, X. LLIMONA (BCC). Cabo de Gata, San José, Cerro de las Cuevas, ca. 150 m, 19.3.1972, X. LLIMONA (BCC).- Catalunya: Girona, Alt Empordà, Roses, Cap de Creus, Cala Jonculs, ca. 30 m, 5.5.1990, X. LLIMONA (BCC). Cadaqués, El Jonquet, 10 m, 4.9.1973, X. LLIMONA (BCC).- Murcia: Aguilas, Lomo Bas, 400 m, 3.3.1979, J.M. EGEA (MUB-736). Cabo de Palos, Atalayón, 180 m, 26.7.1978, J.M. EGEA (MUB-733). Isla Mayor, 25.3.1975, X. LLIMONA (MUB-9049). 30 km of Cartagena, Cala Reona, 20-50 m, 27.9.1987, J. HAFELLNER & J.M. EGEA (hb. Kalb).

Additional specimens examined: **BALEARIC ISLANDS:** Mallorca: Port des Canonge, sea level, 25.10.1983, M. MUS & P.LL. VILALLONGA (hb. Mus).- Menorca: Sa Basa Verda, April 1983, P. LL. VILALLONGA (hb. Mus). **CANARY ISLANDS:** Gran Canaria: Cuesta de Silva, 100 m, 3.1.1984, NARANJO & EGEA (MUB-6939,9047).- Tenerife: Valle Guerra, La Barranquera, 0-25 m, 12.1.1984, J.M. EGEA, X. LLIMONA & PÉREZ DE PAZ (MUB-6940,9048). **MOROCCO:** Tangier: Cabo Spartel, 30-100 m, 14.4.1984, J.M. EGEA & J. ROWE (MUB-9043, 9044).

2. *RINODINA ASPERSA* (BORRER) LAUNDON

LAUNDON 1986: 175.- **type**: British Isles, England, Sussex, on flints, W. BORRER s.n. (BM-lectotype, not seen).

Syn.: *Rinodina fatiscens* (Th. Fr.) Vainio

For further synonyms see JAMES (1965: 97) and LAUNDON (1986: 175).

Icon.: Fig. 2 (chromatogram in solvent systems A, B', C). Further illustrations: LAUNDON (1986: 176, fig. 1; ascospores); MAYRHOFER (1984: 410, fig. 39; distribution, as *R. fatiscens*).

Thallus composed of scattered areolae. Areolae rounded, flat and smooth, whitish to grey, up to 0,5 mm diam., mostly becoming sorediate. Soralia discrete, never forming a continuous leprose crust, punctiform, concolourous or paler than areolae. Prothallus black. Apothecia and spermogonia not seen.

CHEMISTRY: Areolae and soralia K+ yellow and C+ red; atranorin, gyrophoric acid (with lecanoric and orsellinic acids), umbilicaric acid, ovoic acid and 5-*0*-methylhiascic acid, by TLC. Hitherto only atranorin, gyrophoric and lecanoric acids were reported for this species (FOLLMANN & HUNECK 1970; LEUCKERT & MAYRHOFER 1984, as *R. fatiscens*; LAUNDON 1986; FOX & PURVIS 1992). Whereas ovoic acid has not previously been reported from the genus *Rinodina*, the tridepside 5-*0*-methylhiascic acid (ELIX & JAYANTHI 1977), has been detected in *Rinodina tephraspis* (Tuck.) Herre (MAYRHOFER et al. 1992) and in a specimen of the South African species, *R. huillensis* (MATZER & MAYRHOFER in prep.). The chemistry of the species pair *R. aspersa/R. atrocinerea* is close to that of several species of *Umbilicaria* (compare POSNER et al. 1992) and *Lasallia* (compare POSNER et al. 1991).

DISCUSSION: *Rinodina aspersa* is characterized by a thallus composed of discrete soralia and its chemistry. It is the secondary species of *R. atrocinerea,* from which it differs mainly in the production of soredia and the absence (or scarcity) of apothecia and spermogonia. Both species have identical chemistry. No former descriptions of fertile specimens of *R. aspersa* (MAYRHOFER & POELT 1979, as *R. fatiscens*; FOX & PURVIS 1992) mention whether the lumina of the ascospores possess protrusions towards the spore-ends typical of *R. atrocinerea* and *R. alba.*

The sorediate thallus readily distinguishes *R. aspersa* from the other species containing atranorin and gyrophoric acid (e.g. *R. alba* and *R. canariensis*) as well as from the other species treated in the present paper.

According to the various revisions of the genus *Rinodina* (e.g. MAYRHOFER & POELT 1979; MAYRHOFER 1984; GIRALT et al. 1995), *Rinodina aspersa* is the only sorediate species of the genus which contains gyrophoric acid.

ECOLOGY AND DISTRIBUTION: Although *Rinodina aspersa* has been reported from several continental localities (MAYRHOFER & POELT 1979; MAYRHOFER 1984, as *R. fatiscens*), it seems to be mainly a maritime species. It grows on siliceous rocks in coastal sites, from north Scandinavia to south Portugal. According to LAUNDON (1986) its distribution is declining. It has not been reported previously from the study area.

Specimens examined: PORTUGAL: Alentejo: between Alportel and Barranco do Velho, 4 km of Alportel, 10.6.1952, C. TAVARES-4846 (LISU). Near the bridge of Ribeira de Assarias, 10.6.1952, C. TAVARES-4828 (LISU).- Algarve: Ponte da Riba da Foupana, near Cortes S. Tomé, 21.12.1952, C. TAVARES-4982 (LISU, with *Rinodina atrocinerea*).

3. *RINODINA ATROCINEREA* (HOOK.) KÖRBER

KÖRBER 1855: 125.- **type**: Herb. W. Whithering 59 (BM-lectotype, not seen).

Icon.: Fig. 1B (ascospore-ontogeny); Fig. 2 (chromatogram in solvent systems A, B', C). Further illustrations: SHEARD (1967: 330, plate IB; habit; 362, fig. 16; distribution); MAYRHOFER (1984: 378, fig. 8; distribution); FOX & PURVIS (1992: 544, fig. 25c; ascospores).

Thallus thin, areolate. Areolae dispersed to rarely contiguous, rounded, rarely angulose, smooth, flat to subconvex, whitish to grey. Spermogonia usually abundant. Lower surface of the thallus sometimes containing a yellowish-orange pigment reacting K+ and C+ purple red. Apothecia lecanorine, scattered, up to 1 mm diam., subinnate to adnate. Thalline margin thin, entire and usually persistent. Disc brown, plane to rarely subconvex. Epihymenium brown, interspersed with small crystals reacting C+ red (gyrophoric acid, microscopic slide!). Hymenium up to 120 µm high. Asci *Lecanora*-type. Ascospores of typical *Pachysporaria*-type, (13-)16-19(-22) x (8-)9-12(-13) µm, lumina often showing protrusions towards the spore-ends, torus developed, faintly warted.

CHEMISTRY: Thallus and thalline margin K+ and PD+ yellow and C+ red, epihymenium C+ red (microscopic slide!); atranorin, gyrophoric acid (with ±lecanoric and orsellinic acids), umbilicaric acid, ovoic acid and ±5'-*0*-methylhiascic acid, by TLC. Hitherto only atranorin, gyrophoric and lecanoric acids were reported from this species (SHEARD 1967; FOLLMANN & HUNECK 1970; HECKLAU et al. 1981; LAUNDON 1986; FOX & PURVIS 1992). FOX & PURVIS (op. cit.) have also found chloratranorin. The lower surface of the thallus sometimes contains a yellowish-orange pigment which usually reacts K+ and C+ purple red (see below). See also comments under the chemistry of *R. aspersa*.

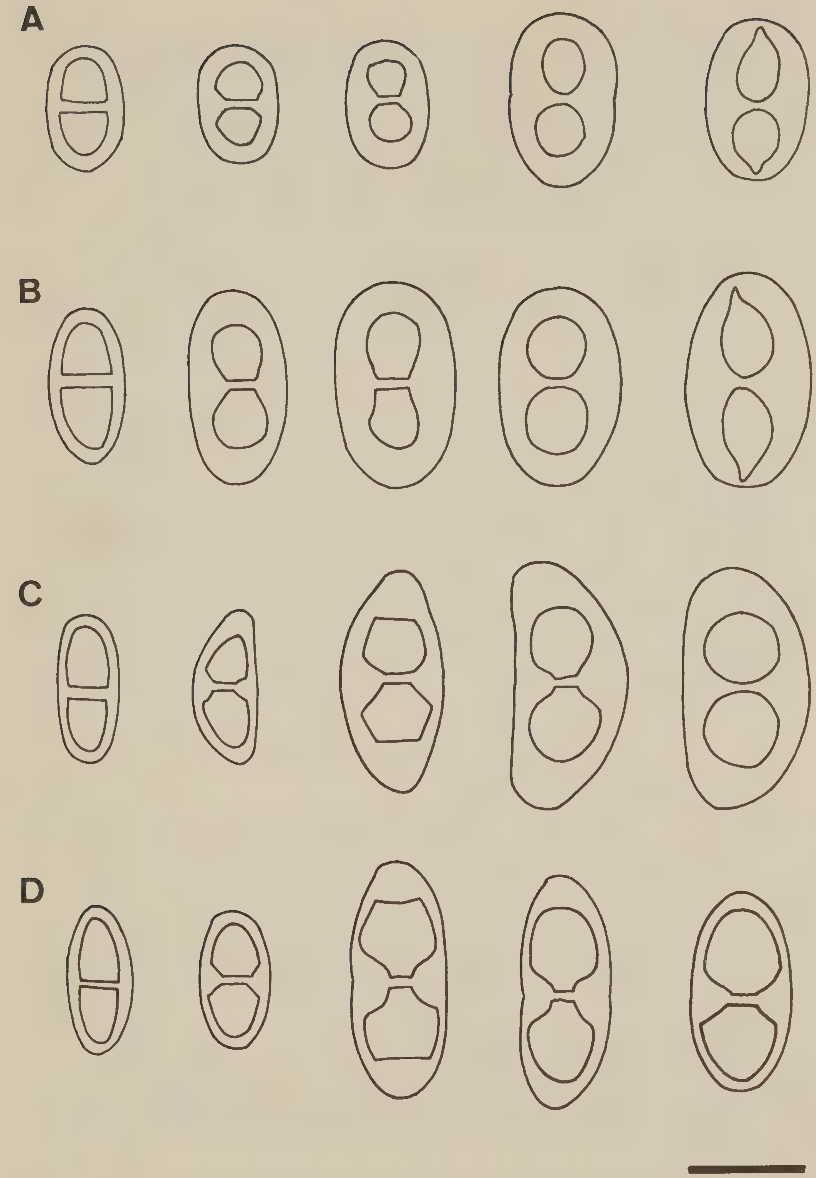
DISCUSSION: *Rinodina atrocinerea* usually extends over a wide area and is characterized by its thin and discontinuous thallus over a black prothallus, its typical *Pachysporaria*-type ascospores and its chemistry. The presence of the yellowish-orange pigment in the lower surface of the thallus which reacts K+ and C+ purple red was cited by MATZER et al. (1994) as a distinguishing character of *R. canariensis*. Our observations show that this pigment may also be present in *R. atrocinerea*. Nevertheless, the latter species cannot be mistaken for *R. canariensis* because this species is usually parasitic and has larger, fusiform and often curved ascospores (which show tendencies towards the *Physcia*-type). Other distinguishing features between the taxa include the absence in *R. atrocinerea*, of the adpressed mycelium of a lichenicolous fungus which often covers the thallus of *R. canariensis* (MATZER et al. 1994). Furthermore, the ascospores of *R. canariensis* do not exhibit the lumina protrudings towards the spore-ends.

Some of the specimens of *R. atrocinerea* examined possessed smaller than usual ascospores and for this reason they could be confused with *R. alba*. In this cases, the absence of the I+ violet medullary reaction and of the unknown secondary lichen substance separate *R. atrocinerea*. Other characters for distinguishing these two species are discussed under *R. alba* (see above).

Rinodina aspersa is the sorediate counterpart of *R. atrocinerea*, the two taxa constituting a species pair in the sense of POELT (1970, 1972). *R. aspersa* differs from *R. atrocinerea* in the production of soredia, in the much reduced thallus development and in the scarcity of apothecia and spermogonia (JAMES 1965; LAUNDON 1986; FOX & PURVIS 1992). The two species are chemically identical (see also comments under *R. aspersa*).

ECOLOGY AND DISTRIBUTION: *Rinodina atrocinerea* is an oceanic species widely distributed from the Atlantic to the western Mediterranean and Macaronesian regions. It occurs on hard siliceous rocks, preferentially in coastal sites, from low to middle altitudes. It has frequently been reported previously from the study area. The records of *R. alba* in SANCHEZ-BIEZMA & LÓPEZ DE SILANES (1992) refer to this species and those in EGEA et al. (1987) from Canary Islands to *R. canariensis*.

Fig. 1: Ascospore-ontogeny of different *Rinodina* species: A: *R. alba* (Spain, Murcia, Cala Reona, 27.9.1987, J. HAFELLNER & J.M. EGEA, hb. Kalb); B: *R. atrocinerea* (Portugal, Beira Litoral, near Cruz Alta, 5.1.1950, C. TAVARES-3277, LISU); C: *R. canariensis* (Canary Islands, Tenerife, Mirador de Guimar, 13.1.1984, J.M. EGEA & X. LLIMONA, MUB-9050); D: *R. luridescens* (Tunisia, Tabarka, 5 km of Melloulat, 27.3.1986, J.M. EGEA, MUB).


A
B
C
D

Specimens examined: PORTUGAL: Algarve: N of Portimão, 6 km WNW of Silves, 20 m, 28.7.1993, P.v.d. Boom-14774, 14801 (hb. v.d. Boom). Serra de Monchique-Caldas, Vale do Paraiso, 24.2.1946, C. Tavares-1558 & L. Sobrinho (LISU). Serra do Monchique, near Caldas, 20.2.1946, C. Tavares-3699 (LISU). Ponte da Riba da Foupana, near Cortes S. Tomé, 21.12.1952, C. Tavares-4982 (LISU).- Beira Litoral: Serra do Bugaço, near Cruz Alta, 5.1.1950, C. Tavares-3277 (LISU). Arganil, Salgueiro, 23.9.1953, C. Henriques-5275 (LISU). Serna da Lous, Senhora da Piedade, 1940, R.T. Palhinha (LISU).- Beira Baixa: Serra da Estrela, Unhais da Serra, Ribeira da Estrela, R. Palhinha (LISU).- Estremadura: Sintra, Convento dos Capuchos, ca. 400 m, 9.8.1987, P.v.d. Boom-6558 (hb. v.d. Boom). Monte de S. Bartolomeu, 23.6.1953, C. Tavares-5295 (LISU).- Minho: 32 km NE of Braga, Parque National da Gerez, N of Gerez, ca. 1000 m, 5.8.1987, P.v.d. Boom-6452 (hb. v.d. Boom). Paso, Melgaço, 1947, C. Tavares-1996 (LISU). Serra do Gerez, Abelheirinha, 770 m, 25.3.1948, C. Tavares-2455 (LISU). Serra do Gerez, Pedra Bela, 18.6.1947, C. Tavares-2088 (LISU). Serra do Gerez, Preguiça, ca. 620 m, 24.3.1948, C. Tavares-2418 (LISU). **SPAIN:** Asturias: Picos de Europa, E of Cangas, SE of Arenas, ca. 1100 m, 13.8.1985, P.v.d. Boom-3304 (hb. v.d. Boom).- Galicia: La Coruña, Santiago de Compostela, Monte Pedroso, 200-450 m, 20.2.1990, M.J. Sanchez-Biezma (SANT-7649, 7672).- Murcia: Aguilas, Cabezo de los Mayorales, 675 m, 18.3.1979, J.M. Egea (MUB-731). La Alberca, W of Cresta del Gallo, 300 m, 11.3.1979, J.M. Egea (MUB-737).

4. *RINODINA BECCARIANA* Bagl. s. lat.

Baglietto 1871: 239.- **type:** Italy, Toscana, Mte. Pisano, Valle delle Fonti, 1862, Beccari (MOD-holotype, not seen).

For synonyms see Mayrhofer et al. (1993: 284, 292).

Exs.: C.N. Tavares: Lich. Lusitaniae sel. exs. 250 (LISU, as *R. subglaucescens*).

Illustrations: Mayrhofer et al. (1993: 283, figs. 1A-B; ascospore-ontogeny; 285, figs. 2-3, 291, fig. 10; habit; 287, figs. 4-5; ascospores; figs. 6-7, spermatiogenous cells and spermatia; 289, fig. 8, 293, fig. 11; distribution).

Thallus usually thick, continuous, composed of areolae. Areolae smooth to granulose, whitish grey to grey. Apothecia lecanorine (var. *beccariana*) or pseudolecanorine (var. *lavicola*), adnate, (0,5-)0,7-1 mm diam., abundant, scattered to confluent. Thalline margin thick, entire to crenulate, persistent (var. *beccariana*) or excluded (var. *lavicola*). Proper margin in section dark brown to blue green and then N+ reddish. Disc dark brown to black, plane to subconvex. Hymenium 70-100 µm tall. Epihymenium dark brown to blue green and then N+ reddish. Asci *Lecanora*-type. Ascospores *Pachysporaria*-type, (15-)16-21(-28) x (6-)8-12(-15) µm, when young showing tendencies towards the *Physcia*-type, warted; torus well developed.

CHEMISTRY: Thallus and thalline margin K+ and PD+ yellow; atranorin, ±chloratranorin and ±zeorin according to MAYRHOFER et al. (1993). Further information is given by HECKLAU et al. (1981) and by MAYRHOFER & LEUCKERT (1985, as *R. subglaucescens*).

DISCUSSION: *Rinodina beccariana* is mainly characterized by its chemistry and its *Pachysporaria*-type ascospores which grade into the *Physcia*-type. Detailed descriptions are provided by MAYRHOFER et al. (1993). Among the other species considered, *R. beccariana* could only be mistaken for *R. confragosa, R. canariensis* and *R. santorinensis*. *R. confragosa* possesses the same chemistry, but can be separated by its typical *Physcia*-type ascospores, while the latter species can be distinguished chemically as they contain gyrophoric acid and pannarin, respectively (see also comments under those species).

R. beccariana is very closely related to the corticolous species *R. roboris.* However they are best maintained as separate taxa because of their different ecology and significantly different distribution (compare GIRALT & MAYRHOFER 1994).

ECOLOGY AND DISTRIBUTION: *Rinodina beccariana* is distributed from Macaronesia to the Mediterranean region, extending north to the British Isles along the Atlantic coast (MAYRHOFER et al. 1993). It occurs on siliceous rocks, mainly in coastal sites, from low to middle altitudes. It is rather frequent in the study area (compare ALONSO 1993), where it has mostly been reported as *R. subglaucescens.* Those records also include specimens of *R. santorinensis* (see MAYRHOFER et al. 1993) as well as specimens of *R. confragosa*. The records of *R. oxydata* in EGEA et al. (1987), from Canary Islands, refer to *R. beccariana* var. *lavicola* while those of *R. milvina* in MUS & EGEA (1989) and *R. confragosa* in MUS (1985) and MUS & EGEA (op. cit.), to *R. beccariana* var. *beccariana.*

Specimens examined which were not listed by Mayrhofer & Poelt (1979), Mayrhofer (1984) and Mayrhofer & al. (1993):

PORTUGAL: Estremadura: Monte de S. Bartolomeu, near Nazaré, 130 m, 9.2.1959, C. TAVARES (LISU, as Tavares: Lich. Lusitaniae sel. exs. 250). Azoia, near de Cabo da Roca, 4.5.1951, C. TAVARES-4218 (LISU). **SPAIN:** Andalucía: Almería, Sierra de Gata, Cabo de Gata, San José, Cerro de las Cuevas, ca. 150 m, 19.3.1972, X. LLIMONA (BCC). Cabo de Gata, San José, El Monsul, 50-100 m, 19.3.1972, X. LLIMONA (BCC). Cabo de Gata, Níjar, Las Negras, Collado de Hortichuela, 300 m, 14.4.1981, X. LLIMONA (BCC).- Catalunya: Barcelona, Baix Llobregat, Torrelles de Llobregat, Torrelletes, Can Mas, ca. 110 m, 17.2.1972, X. LLIMONA (BCC). Torrelles de Llobregat, Torrelletes, Penya del Moro, ca. 220 m, 31.7.1972, X. LLIMONA (BCC). Torrelles de Llobregat, Torrelletes, ca. 200 m, 24.4.1970, X. LLIMONA (BCC). Girona, Alt Empordà, Port de la Selva, Camí Vell de La Selva a Roses, 23.5.1994, X. LLIMONA (BCC). Port de la Selva, Puig Vaquer, 380-400 m, 27.8.1974, X. LLIMONA (BCC). Roses, Carretera de Roses a Jonculs, between Puig Rom and Puig Marés, 120 m, 25.2.1984, X. LLIMONA (BCC).- Murcia: Cabo de Palos, Isla Perdiguera, February 1980, J.M. EGEA (MUB-736). Carmolí, 17.5.1979 (MUB-9046). Isla Grosa, 8.4.1978, J.M. EGEA (MUB-9084). Isla del Ciervo, 25.9.1979, J.M. EGEA (MUB-735). Mazarrón, La Atalaya, 200 m, 26.3.1975, X. LLIMONA (MUB-9045).- Pais Valencià: València, Serra El Garbí, 575 m, 18.10.1992, V. CALATAYUD (VAB).

Additional specimens examined: ***R. beccariana* var. *beccariana*:** **BALEARIC ISLANDS:** Mallorca: Port de's Canonge, sea level, 25.10.1983, M. MUS (hb. Mus).- Menorca: Sa Basa Verda, September 1985, M. MUS & P.LL. VILALLONGA (hb. Mus). La Vall, September 1985, M. MUS & P.LL. VILALLONGA (hb. Mus). Sa Mesquida, 27.8.1988, M. Mus (hb. Mus). **MOROCCO:** Tangier: Cabo Spartel, 30-100 m, 14.4.1984, J.M. EGEA & J. ROWE (MUB-9077, 9082, 9086, 9087). ***R. beccariana* var. *lavicola*:** **CANARY ISLANDS:** Tenerife: Valle Guerra, Los Lázaros, 200 m, 12.1.1984, J.M. EGEA, X. LLIMONA & PÉREZ DE PAZ (MUB-9072). La Barranquera, 0-25 m, 12.1.1984, J.M. EGEA, X. LLIMONA & PÉREZ DE PAZ (MUB-9068, 9073). El Medano, 0-170 m, 10.1.1984, J.M. EGEA, X. LLIMONA & C. HERNÁNDEZ-PADRÓN (MUB-9071). Montaña Centinela, Los Abades, 3.3.1993, N. HLADUN & A. GÓMEZ-BOLEA (BCC).- Gran Canaria: Cuesta de Silva, 100 m, 3.1.1984, NARANJO & J.M. EGEA (MUB-9070). Agaete, Andén Verde, 3.1.1984, NARANJO & J.M. EGEA (MUB-9069). **MADEIRA**: between Ribeiro Frio and Balcoes, 27.7.1951, C. TAVARES-4391 (LISU).

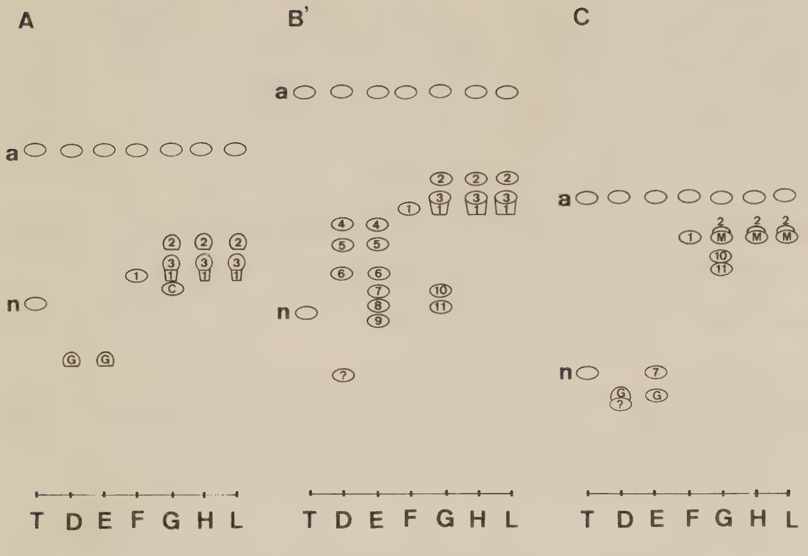


Fig.2: Cromatograms in solvents A, B' and C of: **D**: *R. alba*; **E**: *R. aspersa*; **F, G, H**: *R. trachytica*; **L**: *Lecanora* sp. (India, Andhra Pradesh, *Rao,* DUKE); **T**: references. Substances: **a**: atranorin; **n**: norstictic acid; **G**: gyrophoric series; **C**: confluentic series; **M**: 2'-*0*-methylperlatolic series; **1**: 2'-*0*-methylperlatolic acid; **2**: 2'-*0*-methylsuperlatolic acid; **3**: 2'-*0*-methylisoperlatolic/2'-*0*-methylhyperlatolic acids; **4**: orsellinic acid; **5**: lecanoric acid; **6**: gyrophoric acid; **7**: 5-*0*-methylhiascic acid; **8**: ovoic acid; **9**: umbilicaric acid; **10**: hyperconfluentic acid; **11**: confluentic acid; **?**: unknown substance (2''-*0*-methylgyrophoric acid?).

5. *RINODINA CANARIENSIS* Matzer, Mayrh. & Clerc

Matzer, Mayrhofer, Sattler & Clerc 1994: 105.- **type**: Canary Islands, La Palma, about 1 km N of Punta Cumplida, c. 100 m, on volcanic rocks, 30.11.1991, H. Mayrhofer-10660, M. Koch & M. Matzer (BM, DUKE, H, HO, M, PRM, STU, TBS, UPS, VBI, hb. Kalb, hb. Lumbsch, hb. Vezda-isotypes, as Vezda: Lich. rar. exs. 108, not seen, GZU--holotype!).

Icon.: Fig. 1C (ascospore-ontogeny). Further illustrations: Matzer et al. (1994: 106, fig. 1A; ascospore-ontogeny; 107, figs. 2-7; habit and ascospores; 108, fig. 8; spermatiogenous cells and spermatia; 109, fig. 9; distribution).

Thallus usually parasitic on other crustose lichens, rarely autotrophic, thick, rimose-areolate to areolate. Areolae discrete to contiguous, usually inflated and smooth, grey to dark grey. Prothallus black, often present. Lower surface of the thallus usually containing a yellowish-orange pigment which reacts K+ and C+ purple red. Apothecia lecanorine, sessile, up to 1,3 mm diam. Thalline margin thick, entire and persistent. Disc usually plane, black, often covered with a whitish grey pruina. Epihymenium dark brown, often covered with a coarsely granular epipsamma, C-. Hymenium up to 130 µm high. Asci *Lecanora*-type. Ascospores *Pachysporaria*-type, (16-)19-26(-32) x (8-)9-11(-13) µm, usually showing tendencies towards the *Physcia*-type when young, often curved, warted; torus well developed.

CHEMISTRY: Thallus and thalline margin K+ and PD+ yellow, C+ red; atranorin, chloratranorin, gyrophoric acid with ±lecanoric and orsellinic acids and ±zeorin, according to MATZER et al. (1994). Lower surface of the thallus containing a yellowish-orange pigment usually reacting K+ and C+ purple red.

DISCUSSION: *Rinodina canariensis* is characterized by the typically parasitic thallus, composed of rather thick and inflated areolae and often covered by a mycelium of a lichenicolous fungus, its large *Pachysporaria*-type ascospores which usually grade into the *Physcia*-type and its chemistry. The closely related *R. alba* and *R. atrocinerea* are readily separated by their significantly smaller ascospores, with lumina lacking *Physcia*-type wall thickenings and often having protrusions towards spore-ends (see also comments under those taxa), the thinner thalli and smaller apothecia. For details see MATZER et al. (1994).
R. beccariana and *R. santorinensis,* have similar habit and ascospores, but are mainly distinguished by their alternative chemistry (see also comments under those taxa).

ECOLOGY AND DISTRIBUTION: *Rinodina canariensis* is a rather common species in Macaronesia and occasionally extends north to the Mediterranean region. It generally occurs in coastal sites, from low to moderate altitudes, on volcanic rocks (MATZER et al. 1994). The records of *R. atrocinerea* in EGEA et al. (1987) from the Canary Islands, refer to this species.

Specimen examined: PORTUGAL: Estremadura: Berlenga, near Carreiro do Mosteiro, 14.6.1951, C. TAVARES-4064 (LISU).

Additional specimens examined: CANARY ISLANDS: Tenerife: Mirador de Güimar, 400 m, 13.1.1984, J.M. EGEA & X. LLIMONA (MUB-9050, 9051, 9089).

Los Lázaros, 200 m, 12.1.1984, J.M. EGEA, X. LLIMONA & PÉREZ DE PAZ (MUB-9052).- Gran Canaria: Andén Verde, Agaete, NARANJO & J.M. EGEA (MUB-9079).- La Palma: 6 km of San Nicolás, N of El Charco, ca. 740 m, 28.11.1991, H. MAYRHOFER-10622 & M. KOCH (BCC). E of El Paso, La Cumbrecita, ca. 850 m, 1.12.1991, H. MAYRHOFER & M. KOCH (BCC).

6. *RINODINA CONFRAGOSA* (ACH.) KÖRBER

KÖRBER 1855 125.- **type**: Ach. Coll. 387 (BM-holotype, not seen).

For synonyms see SHEARD (1967: 346), MAYRHOFER & POELT (1979: 86) and MAYRHOFER (1984: 397).

Icon.: Fig. 2A (ascospore-ontogeny). Further illustrations: SHEARD (1967: 329, fig. 1, 335, fig. 5A; ascospores; 360, fig. 8; distribution); MAYRHOFER (1984: 398, fig. 22; distribution); MAYRHOFER et al. (1993: 283, fig. 1F; ascospore-ontogeny); MATZER et al. (1994: 106, fig. 1C; ascospore-ontogeny)

Thallus usually thick and continuous, rimose to areolate, smooth to rugose, whitish, pale grey or pale green (ochraceous in herbarium). Prothallus usually absent. Apothecia lecanorine, usually sessile, abundant, up to 1,5 mm diam. Thalline margin thick, entire to crenulate, persistent. Disc dark brown to black, plane to convex. Hymenium 80-100 µm tall. Epihymenium dark brown. Asci *Lecanora*-type. Ascospores *Physcia*-type, (16-)18-23(-27) x (7-)8-10(-12) µm, warted; torus well developed.

CHEMISTRY: Thallus and thalline margin K+ and PD+ yellow; atranorin, ±chloratranorin and zeorin, by TLC. Further data are given by HECKLAU et al. (1881) and MAYRHOFER & LEUCKERT (1985).

DISCUSSION: In the area studied, *Rinodina confragosa* is a rather invariant species, well characterized by its well developed thallus, the large lecanorine apothecia and the large *Physcia*-type ascospores. Among the other species treated, *R. confragosa* could only be mistaken for *R. occulta* which also has *Physcia*-type ascospores. However the latter species is well separated by smaller pseudolecanorine apothecia and ascospores (see also comments under *R. occulta*). *R. beccariana* is similar in appearance but is distinguished by its *Pachysporaria*-type ascospores and different ecology.

The corticolous *Rinodina capensis* is closely related to *R. confragosa* but possesses a thicker I+ blue apothecial cortex, smaller apothecia and thinner thallus (compare GIRALT & MAYRHOFER 1994).

ECOLOGY AND DISTRIBUTION: *Rinodina confragosa* is a submontane to montane species, widely distributed in Europe, from northern Scandinavia to the southern Mediterranean regions (NIMIS 1993). In the Iberian Peninsula it occurs from moderate to high altitudes on hard siliceous rocks. It is common throughout the study area (TAVARES 1945; EGEA & LLIMONA 1981a; 1981b; HLADUN 1985; CALATAYUD & BARRENO 1994). Some former records refer either to *R. beccariana* (eg. MUS 1985; MUS & EGEA 1989) or to *R. santorinensis* (e.g. BALLESTEROS 1982).

Specimens examined: **PORTUGAL:** Alto Alentejo: near Évora, 19.5.1957, C. TAVARES-5970 (LISU). Between Bencatel and Redondo, 24.12.1953, C. TAVARES-5424 (LISU).- Beira-Alta: Serra da Estrela, near Penhas da Saude, 1600 m, 3.8.1949, C. TAVARES-3115 (LISU). Caldas de Manteigas, 900 m, 8.1944, C. TAVARES-1336 (LISU).- Trás-os-Montes: between Vila Real and Murça, 13.4.1957, C. TAVARES-5873 (LISU). **SPAIN:** Andalucía: Almería, Tabernas, Pico Alhamilla, 1365 m, 31.3.1979, J.M. EGEA (MUB-886). Granada, Sierra Nevada, Peñón de St. Francisco, 28.9.1980, J.M. EGEA & X. LLIMONA (MUB-885).- Castilla-León: Palencia, Camporredondo de Alba, 1600 m, 6.7.1991, A. TERRÓN & M.E. LÓPEZ DE SILANES (LEB-198, 212, 213). León, Peña de la Serna, 1350 m, 24.6.1989, A. TERRÓN (LEB-209). Las Reguellinas-El Peñasco, 1800 m, 15.4.1987, A. TERRÓN (LEB-200). Mascariel, 1650 m, 23.7.1989, A. TERRÓN (LEB-210).- Castilla-La Mancha: Albacete, Sierra del Relumbrar, Alcaraz, ca. 1000 m, 7.10.1978, J.M. EGEA (MUB-781). Cuenca, Talayuelas, Pico Ranera, 1400 m, V. CALATAYUD (VAB).- Catalunya: Barcelona, Montseny, Puig de sa Carbassa, 15.11.1975, X. LLIMONA & N. HLADUN (hb. Hladun-96, 106). NE de Coll Formic, ca. 1500 m, 28.5.1983, H. MAYRHOFER & N. HLADUN (BCC). Km 23 road Sant Celoni-Sant Marçal, 1370 m, 18.10.1975, N. HLADUN (BCC).- Pais Valencià: Castelló, Pina de Montalgrao, Santa Bàrbara, 1300 m, 21.3.1992, V. CALATAYUD (VAB).

Additional specimen examined: **BALEARIC ISLANDS:** Mallorca: Escorca, 600 m, M. MUS (hb. Mus).

7. *RINODINA LURIDESCENS* (ANZI) ARNOLD

ARNOLD 1872: 39.- **type**: Italy, Toscana, "ad rupes et saxa granitica in Castanearum sylvis di Monti Pisano", *Anzi* (Anzi: Lich. rar. etr. exs 20, M, ZT, BM-isotypes, not seen).

Icon.: Fig. 1C (ascospore-ontogeny). Further illustrations: SHEARD (1967: 330, plate IIA; habit; 362, fig. 11; distribution); MAYRHOFER (1984: 434, fig. 59; distribution); FOX & PURVIS (1992: 544, fig. 25b; ascospore).

Thallus continuous, thick, rimose-areolate, grey to grey-brown. Prothallus black, usually present. Apothecia pseudolecanorine from the beginning, persistently immersed, up to 1,2 mm diam. Disc plane to subconvex, brown. Proper margin thin, darker than the disc, usually persistent. Epihymenium and proper excipulum reddish brown, interspersed with small crystals which react C+ red (gyrophoric acid, microscopic slide!). Hymenium up to 100 µm high. Hypothecium brownish. Asci *Lecanora*-type. Ascospores *Physconia*-type (including *Milvina*-type), (16-)19-21(-22) x (7,5-)9-11(-12) µm, warted; torus well developed.

CHEMISTRY: Thallus C+ faintly red, epihymenium and proper margin C+ red (microscopic slide!); gyrophoric acid (with lecanoric and orsellinic) and zeorin, by TLC (compare HECKLAU et al. 1981). Further information is given by FOX & PURVIS (1992).

DISCUSSION: *Rinodina luridescens* is characterized by its chemistry, its immersed, pseudolecanorine apothecia, its brownish hypothecium and its *Physconia*-type ascospores. The absence of atranorin together with the other distinguishing characters cited separate *R. luridescens* from the other species containing gyrophoric acid, as well as from all the other species treated.
According to MAYRHOFER (1984) and MATZER et al. (1994) the ascospores of *R. luridescens* belong to the *Milvina*-type rather than to the *Physconia*-type. We include the *Milvina*-type in the *Physconia*-type because mature ascospores are identical in both types: i.e. they only possess septal wall-thickenings. In intermediate ontogenetic stages ascospores belonging to the *Milvina*-type may also possess apical wall-thickenings, while these are quite rare in the *Physconia*-type (compare GIRALT 1994; GIRALT & MAYRHOFER 1995).

ECOLOGY AND DISTRIBUTION: *Rinodina luridescens* is a maritime Mediterranean-Atlantic species, extending as far as the Black Sea (NIMIS 1993). It is found in coastal sites, on hard siliceous rocks. In the Iberian Peninsula it is currently known only from Galicia (MAYRHOFER 1984; BAHILLO et al. 1987). The records of *R. luridescens* from Mallorca (Balearic Islands) in MUS & EGEA (1985) do not refer to a *Rinodina* species. It has also been reported from Menorca (MUS 1985, specimens not seen) and from Tunisia (EGEA et al. 1990).

Specimen examined: TUNISIA: Tabarka, 5 km of Melloulat, 100 m, 27.3.1986, J.M. Egea (MUB).

8. *RINODINA OCCULTA* (KÖRBER) SHEARD

SHEARD 1967: 349.- **type**: "ad rupes umbrosas faucis Wolfsschlucht in monte Kynast Sudetorum", KÖRBER (M--holotype!, as Körber: Lich. sel. germ 34).

New synonym: *Rinodina attica* Mayrhofer & Poelt 1979: 58.- **type**: Greece, Attika: Hymettos, ca. 700 m, 4.1954, J. POELT (M--holotype!, GZU--isotype!).

For further synonyms see SHEARD (1967: 349), SHEARD (1973: 462) and MAYRHOFER & POELT (1979: 125).

Exs.: Sampaio: Lichenes de Portugal 196 (M).

Icon.: Fig. 2B-C (ascospore-ontogeny). Further illustrations: SHEARD (1967: 330, fig. 7; distribution, including *R. interpolata*). MAYRHOFER (1984: **444**, fig. 70; distribution).

Thallus thin, ±continuous to areolate. Areolae discrete to contiguous, small, thin, smooth, whitish to grey. Prothallus brown to black. Apothecia first lecanorine and ±innate, usually becoming pseusolecanorine and adnate, dark brown to black, usually abundant and confluent, up to 0,3 mm diam. Disc plane to convex. Proper exciple concolorous with the disc, thin, persistent or not. Epihymenium dark brown. Hymenium 60-80 µm high. Asci *Lecanora*-type. Ascospores *Physcia*-type, (10-)13-16(-18) x (5,5-)6-8 µm, some of them, when mature, showing tendencies towards the *Physconia*-type, warted; torus not or poorly developed.

CHEMISTRY: Thallus and thalline margin (when present) K+ and PD+ yellow; atranorin and ±chloratranorin, by TLC. Further data are given by SHEARD (1973), HECKLAU et al. (1981) and MAYRHOFER & LEUCKERT (1985, as *R. attica*).

DISCUSSION: *Rinodina occulta* is characterized by its thin thallus which only reacts K+ yellow (atranorin), its small and usually abundant apothecia which often become pseudolecanorine and its small *Physcia*-type ascospores.

As no marked differences were observed between the specimens of *Rinodina attica* studied and those belonging to *R. occulta* (types included), the former is now placed in synonymy.

Among the other species treated, *R. occulta* could only be mistaken for *R. confragosa* since this species also possesses *Physcia*-type ascospores. The latter species is well separated by the better developed and thicker thallus, larger and persistently lecanorine apothecia and larger ascospores.

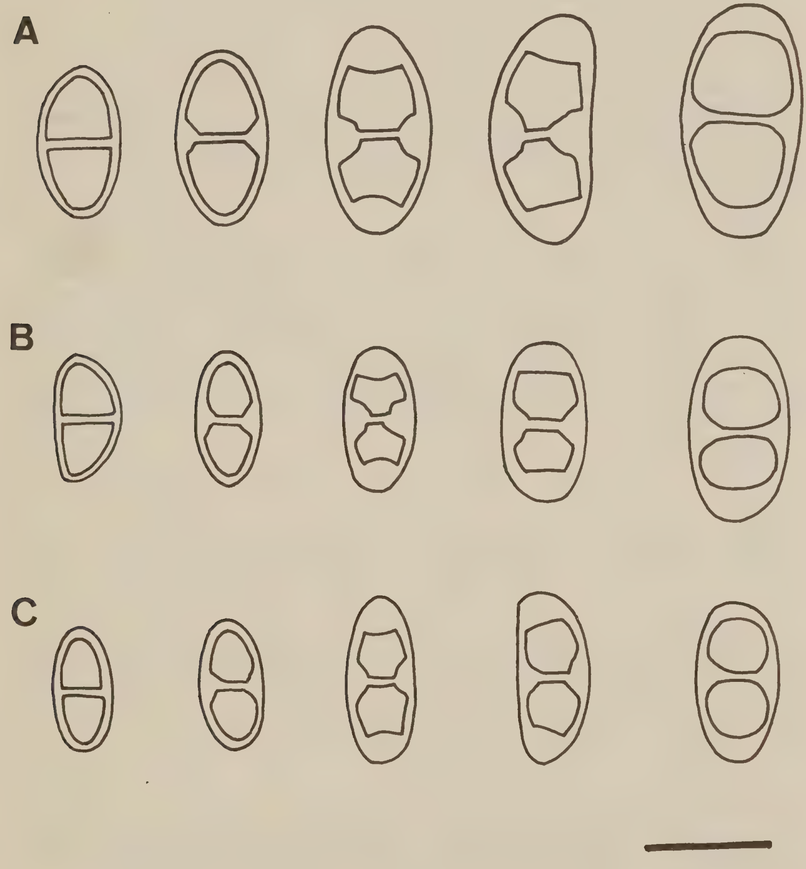


Fig. 3: Ascospore-ontogeny of different *Rinodina* species: A: *R. confragosa* (Portugal, Beira Alta, Caldas de Manteigas, 1944, C. TAVARES-1336, LISU); B:; *R. occulta* (M-holotype); C: *R. attica* (M-holotype).

However like *R. occulta, R. beccariana* var. *lavicola*, *R. oxydata* and *R. vezdae* have apothecia which usually become pseudolecanorine and contain atranorin as the only major lichen compound. All are readily separated by their different ascospore-type and size.

Previously, *Rinodina occulta* has often been confused with *R. interpolata*, a species with a similar habit but lacking atranorin and possessing typical *Physconia*-type ascospores (SHEARD 1973).

Further, the corticolous/lignicolous species *R. exigua* appears to be closely related to *R. occulta* (compare GIRALT & MAYRHOFER 1994).

ECOLOGY AND DISTRIBUTION: *Rinodina occulta* is an uncommon but widely distributed species in western Europe, occurring from Scandinavia to the Mediterranean regions (NIMIS 1993). It grows on hard siliceous rocks, preferently in shaded situations. In the Iberian Peninsula it is known only from a few localities (e.g. EGEA & LLIMONA 1981a; MAYRHOFER 1984; ROWE & EGEA 1985).

Additional specimens examined: PORTUGAL: Póvoa de Lanhoso, Nasce, 1921, G. SAMPAIO (M, as Sampaio: Lichenes de Portugal 196).- Tras-os-Montes: Ribeira de Samapio, near Chaves, 15.4.1957, C. TAVARES-5943 (LISU). **SPAIN:** Andalucía: Almería, Tabernas, Pico Alhamilla, 1365 m, 22.9.1979, J.M. EGEA (GZU, MUB-9067).- Catalunya: Barcelona, Orrius, Turó dels Séllecs, Parc Natural de St. Mateu, 550 m, 19.12.1993, M. BARBERO & X. LLIMONA (BCC).

9. RINODINA OXYDATA (MASSAL.) MASSAL. S. LAT.

MASSALONGO 1854: 19.- **type:** Italy, Verona, "in oppido Lavagno, ad saxa basalti", MASSALONGO (VER-holotype, not seen).

For synonyms see SHEARD (1967: 353); MAYRHOFER & POELT (1979: 132) and MAYRHOFER (1984: 446).

Exs.: Sampaio: Lichenes de Portugal 186 (LISU).

Icon.: Fig. 4A (ascospore-ontogeny). Further illustrations: SHEARD (1967: 329, fig. 1D, 336, fig. 6; ascospores; 363, fig.14; distribution). MAYRHOFER (1984: 447, figs. 73-74; distribution); FOX & PURVIS (1992: 544, fig. 25k; ascospores).

Thallus thin, smooth, rimose or of discrete, plane and smooth areoles, whitish (ochraceous in herbarium) to pale grey. Prothallus black, frequently present. Apothecia at first lecanorine and ±immersed, becoming pseudolecanorine and adnate, usually scattered, up to 0,8 mm diam. Thalline margin concolorous with thallus, thin, usually excluded. Disc plane to subconvex, brown. Proper margin dark brown to black, persistent, usually darker than the disc, in section often with a greenish black pigment which reacts N+ reddish. Epihymenium brown. Hymenium 70-110 µm high. Asci variable, of *Lecanora*-type or intermediate between the *Lecanora-* and the *Bacidia*-type. Ascospores *Mischoblastia*-type, (17-)19-23(-26) x (9-)10-12(-13) µm, warted; torus poorly developed.

CHEMSITRY: Thallus and thalline margin (when present) K+ and PD+ yellow; atranorin, by TLC. Further data are given by HECKLAU et al. (1981).

DISCUSSION: According to MATZER & MAYRHOFER (in prep.), *Rinodina oxydata* must be treated as an species aggregate until a thorough world-wide revision is carried out. Under *R. oxydata* we have included specimens with a thin thallus containing only atranorin and which have apothecia which usually become pseudolecanorine and contain large *Mischoblastia*-type ascospores. *R. vezdae*, a member of the *R. oxydata*-group, differs from the specimens called *R. oxydata* here by its thicker and better developed thallus, larger apothecia which rarely become pseudolecanorine and significantly larger ascospores.

Rinodina trachytica, which also possesses *Mischoblastia*-type ascospores, can be distinguished from *R. oxydata* and *R. vezdae,* by its smaller, cryptolecanorine apothecia, its significantly smaller ascospores and, mainly, by its different chemistry. *R. trachytica* contains several depsides in addition to atranorin (see below).

Another member of the *R. oxydata*-group present in the study area is the corticolous *R. euskadiensis* (compare GIRALT & MATZER 1994).

Rinodina teichophila, another saxicolous species occurring in the study area with large, *Mischoblastia*-type ascospores, can be readily separated from *R. oxydata* (*R. vezdae* included) by the lack of atranorin (compare MATZER & MAYRHOFER 1994).

ECOLOGY AND DISTRIBUTION: *Rinodina oxydata* is a widespread cosmopolitan species, present all over the world (EGAN 1987; NIMIS 1993). In the study area its ecology is poorly known. *R. oxydata* mainly occurs in the montains, at moderate altitudes, on hard siliceous rocks. There are only a few records from the Iberian Peninsula (MAYRHOFER 1984; LÓPEZ DE SILANES &

CARBALLAL 1991; BOOM & GÓMEZ-BOLEA 1991). *R. oxydata* has also been reported by MUS & EGEA (1989) from the Balearic Islands. The record of *R. trachytica* in BOOM & GÓMEZ-BOLEA (1991) which also cited in MAYRHOFER et al. (1992), refer to this species, but those in EGEA et al. (1987) from the Canary Islands belong to *R. beccariana* var. *lavicola.*

Specimens examined: PORTUGAL: Algarve: Serra de Monchique-Caldas, Vale do Paraiso, 24.2.1946, C. TAVARES-1565,1567 (LISU).- Beira Alta: Serra da Estrela-Caldas de Manteigas, 11.8.1944, C. TAVARES-1139 (LISU). Póvoa de Lanhoso: Rendufinho, 1921, G. SAMPAIO (LISU, as Sampaio: Lichenes de Portugal 186). **SPAIN:** Catalunya: Barcelona, Montseny, 6 km NNW of St. Celoni, 3 km NW of Gualba de Dalt, 700 m, 7.7.1989, P.V.D. BOOM-8591 (Hb. v.d. Boom). Vallès Oriental, Parc Natural del Corredor, Sant Martí del Montnegre, 4.3.1989, M. BARBERO-485, 486 (BCC).- Extremadura: 40 km ENE of Plasencia, N of Jarandilla, 1 km N of Guijo de Santa Bárbara, 950 m, 19.7.1989, P.V.D. BOOM-8819 (hb. v.d. Boom) - Navarra: Valle del Baztán, Arregui, 1 km NE Oronoz-Mugaire, 21.7.1993, J. ETAYO & O. BREUSS-9613 (hb. Breuss).- Pais Valencià: Castelló, Almedíjar, 500 m, 14.9.1991, V. CALATAYUD (VAB).

Additional specimen examined: **BALEARIC ISLANDS:** Mallorca: Clot d'Aubarca, 350-400 m, 15.8.1985, M. MUS (hb. Mus).

10. RINODINA SANTORINENSIS J. STEINER S. LAT.

STEINER 1919: 55.- **type**: Greece, Santorin Island, between Thira and Pyrgos, 1911, R. WETTSTEIN (W-lectotype, not seen).

Exs.: Follmann: Lich. sel. exs. 219 (M, hb. Kalb, as *Rinodina confragosa*). Sampaio: Lich. de Portugal 194 (as *Rinodina confragosa* var. *olivieri*, LISU--isotype!).

Illustrations: MAYRHOFER et al. (1993: 283, figs. 1C-D; ascospore-ontogeny; 291, fig. 10, 299, figs. 14-18; habit and ascospores; 300, fig. 19; distribution).

Thallus usually parasitic, thick and rough (var. *santorinensis*) or autotrophic, thin and smooth (var. *olivieri*), areolate. Areolae discrete, plane to frequently inflated, usually lobate and appearing subsquamulose, whitish-grey (ochraceous in herbarium) to ±dark grey. Prothallus black. Apothecia lecanorine, sessile, up to 1,7 mm diam. Thalline margin thick, entire to crenulate, persistent. Disc dark brown to black, sometimes covered by a whitish grey pruina, plane. Epihymenium brown, rarely covered by a granular epipsamma PD+ orange (pannarin, microscopic slide!). Hymenium 70-90 µm high. Ascospores *Pachysporaria*-type, (15-)17-19(-21) x 8-12 µm, when young showing tendencies towards the *Physcia*-type, warted; torus well developed.

CHEMISTRY: Thallus and thalline margin K+ yellow and PD+ orange, epihymenium rarely PD+ orange; atranorin, ±chloratranorin and pannarin, by TLC (MAYRHOFER et al. 1993). The sporadic presence of pannarin crystals in the epihymenium was omitted in MAYRHOFER et al. (op. cit) and GIRALT et al. (1994).

DISCUSSION: *Rinodina santorinensis* is mainly characterized by its typically lichenicolous, almost subsquamulose thallus, its *Pachysporaria*-type ascospores which grade into the *Physcia*-type when young, and, especially, by the presence of pannarin. Detailed information is given by MAYRHOFER et al. (1993). *Rinodina beccariana* and, especially, *R. canariensis* are morphologically rather similar in habit and ascospore-type, but are readily distinguished by their lack of pannarin. The same feature also separates the other species treated.

Whereas pannarin seems to be a relatively frequent metabolite among corticolous *Rinodina* species, among saxicolous species it is hitherto only known from *R. santorinensis* and the Australasian, *R. murrayii* (MAYRHOFER 1983; GIRALT et al. 1994).

ECOLOGY AND DISTRIBUTION: *Rinodina santorinensis* is a maritime, Macaronesian-Mediterranean species. It occurs at coastal sites on different types of siliceous rocks. In the Iberian Peninsula it has commonly been reported as *R. subglaucescens*. For further details see MAYRHOFER et al. (1993). The record of *R. confragosa* in BALLESTEROS (1982) as well as that of *R. pertusariophila* nom. nud. in EGEA (1978), refer to this species.

Specimens examined which were not listed by MAYRHOFER & POELT (1979), MAYRHOFER (1984) and MAYRHOFER et al. (1993):

SPAIN: Andalucía: Almería, Cerro del Labrador, Rodalquilar, 200 m, 14.9.1975, X. LLIMONA (BCC).- Catalunya: Girona, N of Blanes, at Costa Brava, 1971, G. FOLLMANN (M, hb. Kalb; Follmann: Lich. sel. exs. 219, as *Rinodina confragosa*).- La Selva, Tossa de Mar, Sa Bauma, 15-100 m, 28.12.1979, E. BALLESTEROS (BCC).- Murcia: Cabo de Palos, Isla del Ciervo, 24.8.1983, J.M. EGEA (MUB-5026). Atalayón, ca. 40 m, 24.9.1983, J.M. EGEA (MUB-5028). Atalayón, 180 m, 29.12.1976, J.M. EGEA (MUB-801). **PORTUGAL:** Póvoa do Lanhoso, Castelo, 1921, G. SAMPAIO (Sampaio, Lich. de Portugal 194, as *R. confragosa* var. *olivieri*, LISU-isotype)

11. *RINODINA TRACHYTICA* (MASSAL.) BAGL. & CAR.

BAGLIETTO & CARESTIA 1880: 209.- **type**: Italy, "ad trachytica saxa" Colli Euganei, S. Daniele, 1851, A. MASSALONGO (VER-lectotype; BM, K in BM, VER-isolectotypes, not seen).

For synonyms see MAYRHOFER & POELT (1979: 150), MAYRHOFER (1984: 469) and MAYRHOFER et al. (1992: 457).

Icon.: Figs. 4C (ascospore-ontogeny). Fig. 2 (chromatogram in solvents systems A, B' and C). Further illustrations: MAYRHOFER (1984: 422, fig. 51; ascospores, as *R. iberica*; 469, fig. 98; distribution). MAYRHOFER et al. (1992: 457, fig. 7; ascospores; 458, fig. 8; distribution).

Thallus thin or thick, areolate. Areolae discrete to usually contiguous, ±angulose, plane to subconvex, smooth, whitish to grey. Prothallus black. Apothecia abundant, cryptolecanorine to lecanorine, occasionally becoming pseudolecanorine, 0,3-0,6(-0,8) mm diam. When lecanorine or pseudolecanorine then adnate. Thalline margin (when present) thin and entire. Disc dark brown to black, plane to subconvex. Epihymenium brown. Hymenium 70-90 µm high, often parasited by a lichenicolous fungus. Asci *Lecanora*-type. Ascospores *Mischoblastia*-type (14-)16-19(-23) x (7,5-)8-10(-12) µm, some of them showing tendencies to the *Pachysporaria*-type, warted; torus developed. Asci and ascospores often poorly developed. Cortical tissues of the areolae and excipulum, as well as epihymenium, often with a blue green pigment reacting N+ reddish.

CHEMISTRY: Thallus and thalline margin K+ and PD+ yellow; atranorin, 2'-*0*-methylsuperperlatolic acid, 2'-*0*-methylisohyper-latolic/2'-*0*-methylhyperlatolic acids, 2'-*0*-methylperlatolic acid and ±confluentic acid and ±hyperconfluentic acid, by TLC. Further data are given by MAYRHOFER & LEUCKERT (1985, also as *R. iberica*) and MAYRHOFER et al. (1992).
TLC analyses show that the principal lichen compounds of *R. trachytica* are 2'-*0*-methylsuperperlatolic and 2'-*0*-methylisohyperlatolic and/or 2'-*0*-methylhyperlatolic acids, and not, as it has been repeatedly cited in the literature, 2'-*0*-methylperlatolic acid which, except in one of the specimens

analyzed, is always present in low concentrations. One of these acids was previously mentioned as an unknown *p*-depside of the orcinic type (MAYRHOFER & LEUCKERT 1985; MAYRHOFER et al. 1992).

According to ELIX et al. (1987) and CULBERSON et al. (1987), 2'-*0*-methylsuperperlatolic, 2'-*0*-methylisohyperlatolic and 2'-*0*-methylhyperlatolic acids are orcinol-type depsides biosynthetically closely related to the 2'-*0*-methylperlatolic acid.

Those orcinol-type depsides separate better in solvent B' (CULBERSON & JOHNSON 1982) and can be identified as follows: the slowest member of the series corresponds to the well known 2'-*0*-methylperlatolic acid; the fastest to 2'-*0*-methylsuperlatolic acid and the chromatographically intermediate to 2'-*0*-methylisohyperlatolic and/or 2'-*0*-methylhyperlatolic acids. The latter two compounds run together and usually constitute the major secondary product of *R. trachytica* (see Fig. 2).

The same array of lichen compounds were found in *Haematomma pachycarpum* and in an unidentified *Lecanora* sp. from India (CULBERSON et al. 1987). A comparison of this *Lecanora* (Andhra Pradesh: Warangal, *Rao*, s.d. DUKE) with *R. trachytica* showed that both species contain the 2'-*0*-methylperlatolic acid chemosyndrome with identical chromatographic profiles (see Fig. 2). The same series of compounds have been found in *Biatora sorediosa* (ELIX & DAVID 1991) and in *Lecanora jamesii* (BRODO & ELIX 1993).

In contrast to literature reports, confluentic acid (with hyperconfluentic acid) is not always present in *R. trachytica*. Hyperconfluentic acid is visible in solvent B' and C and chromatographically is situated just above the confluentic acid (see Fig. 2).

This constitutes the first reported occurrence of the higher homologues of 2'-*0*-methylperlatolic acid and of hyperconfluentic acid from the genus *Rinodina*.

DISCUSSION: *Rinodina trachytica* is characterized by the thallus of contiguous, ±angulose areolae, the cryptolecanorine apothecia, *Mischoblastia*-type ascospores and complex chemistry. Among the species treated, *R. trachytica* is the only species containing 2'-*0*-methylperlatolic acid, confluentic acid and their homologues.

R. oxydata and *R. vezdae* also possess *Mischoblastia*-type ascospores, but can be distinguished by their larger ascospores and different chemistry (see also comments under those taxa).

ECOLOGY AND DISTRIBUTION: *Rinodina trachytica* is a rather common species throughout the Mediterranean and submediterranean regions where it grows on various siliceous rocks. For further details see MAYRHOFER et al. (1992). There are only a few records from the southern Iberian Peninsula (e.g. MAYRHOFER 1984; ROWE & EGEA 1985; MAYRHOFER et al. op. cit.). It is also known from the Balearic Islands (MUS & EGEA 1989) and from Morocco (EGEA & ROWE 1987). The records in HLADUN (1979) refer to *R. milvina,* and that in BOOM & GÓMEZ-BOLEA (1991), which also cited by MAYRHOFER et al. (1992), refers to *R. oxydata.*

Selected specimens examined: PORTUGAL: Algarve: Castro Marim, 1951, C. TAVARES-4008 (LISU). Ponte da Riba da Foupana, near Cortes de St. Tomé, 21.12.1952, C. TAVARES-4978 (LISU).- Alto Alentejo: Mourao, near de bridge of the river Guadiana, 31.12.1954, C. TAVARES-5630 (LISU).- Baixo Alentejo: Mértola, 21.12.1952, C. TAVARES-4996* (LISU).- Minho: Peso, Melgaço, 1947, C. TAVARES-1991* (LISU).- Tras-os-Montes: near Moncorvo, 15.6.1958, C. TAVARES-6359* (LISU). **SPAIN:** Castilla-La Mancha: Albacete, Cañada del Conejo, 7.10.1978, J.M. EGEA (MUB-734). Ciudad-Real, Campo de Calatrava, Almagro, Cerro volcánico de Almagro, 18.4.1973, X. LLIMONA (BCC). (*records already cited by MAYRHOFER et al. 1992).

Additional specimens examined: **BALEARIC ISLANDS:** Mallorca: Clot d'Aubarca, 350-400 m, M. MUS (hb. Mus). Port d'es Canonge, sea level, October 1985, M. MUS (hb. Mus). **CANARY ISLANDS:** Tenerife: Valle Guerra, La Barranquera, 0-25 m, 12.1.1984, J.M. EGEA, X. LLIMONA & PÉREZ DE PAZ (MUB-9063). **MOROCCO:** Jebel Tazzeka, between Sidi Abdallah and Bad Bou Idir (Taza), 1400 m, 22.4.1984, J.M. EGEA (MUB-9092).

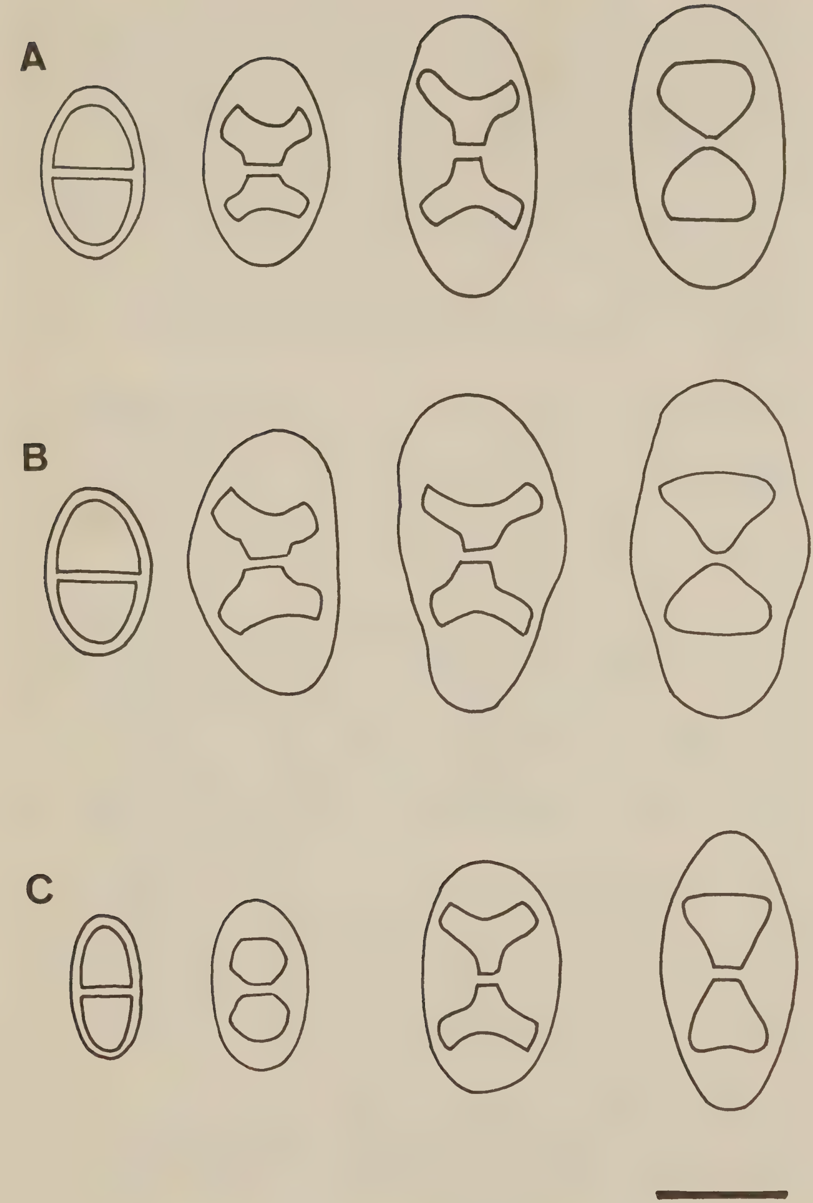
12. *RINODINA VEZDAE* MAYRHOFER

MAYRHOFER 1984: 473.- **type**: CSSR, Moravia occid., Vev. Bityska, "ad saxa dioritica in valle fluvii" Svratka, ca. 350 m, 12.2.1956, VEZDA (M-holotypus, not seen).

For synonyms see MAYRHOFER (1984: 473).

Icon.: Figs. 4B (ascospore-ontogeny). Further illustration: MAYRHOFER (1984: 473, fig. 103; distribution).

Fig. 4: Ascospore-ontogeny of different *Rinodina* species: A: *R. oxydata* (Portugal, Algarve, Vale do Paraiso, 24.2.1946, C. TAVARES-1565, LISU); B: *R. vezdae* (Spain, Castelló, Azuebar, Barranco Mosquera, 14.2.1992, V. CALATAYUD, GZU); C: *R. trachytica* (Portugal, Baixo Alentejo, near Mourao, 1.12.1955, C. TAVARES-5763, LISU).


A
B
C

Thallus rather thick, crustose to subsquamulose, areolate or not, usually continuous, smooth, pale grey to yellowish (ochraceous in herbarium). Prothallus black, present or not. Apothecia cryptolecanorine to lecanorine, rarely becoming pseudolecanorine, up to 1 mm diam. When lecanorine or pseudolecanorine, then adnate. Thalline margin thin, entire, paler than the thallus, usually persistent. Disc brown, plane to convex. Epihymenium brown. Hymenium up to 100 µm high. Asci *Lecanora*-type or, some of them, showing tendencies to the *Bacidia*-type. Ascospores *Mischoblastia*-type, (21-)24-27(-30) x (10-)12-14(-16) µm, faintly warted; torus poorly developed.

CHEMISTRY: Thallus and thalline margin K+ and PD+ weakly yellow; traces of atranorin by TLC. Further data are given by MAYRHOFER (1984).

DISCUSSION: In our oppinion, the characters used for the delimitation of *R. vezdae* fall within the variability of *R. oxydata*, but until a thorough revision of the *R. oxydata*-group is carried out, we refrain from putting them into synonymy (see comments under *R. oxydata*).
As with *R. oxydata, R. vezdae* could not be mistaken for *R. trachytica* because of its larger ascospores and different chemistry.

ECOLOGY AND DISTRIBUTION: The ecology and distribution of *Rinodina vezdae* is poorly known, since it has only been reported from a few central European, submediterranean and Mediterranean localities (MAYRHOFER 1984; MAYRHOFER 1987; NIMIS 1993). In the Iberian Peninsula so far it is only known from Castelló (CALATAYUD & BARRENO 1994), where it grows on south-exposed siliceous rock surfaces, as well as in fissures filled with sand. The specimens cited below constitute the first records from Balearic Islands and Morocco. The latter constitutes the most southern locality for this species.

Specimens examined: SPAIN: Pais Valencià: Castelló, Azuebar, Barranco Mosquera, 620 m, 15.4.1990, V. CALATAYUD, BARRENO, SANZ & FOS, 26.10.1990 and 14.2.1992, V. CALATAYUD (GZU, VAB). Alcúdia de Veo, 600 m, 10.10.1988, BARRENO, ATIENZA, PUCHE & SANZ (VAB). Almenara, La Frontera, 230 m, V. CALATAYUD (VAB). València, Serra Font del Berro, 550 m, 14.12.1990, V. CALATAYUD (VAB). Puçol, El Picaio, 350 m, 16.7.1990, V. CALATAYUD (VAB).

Additional specimens examined: **BALEARIC ISLANDS:** Mallorca: Torrent de Mortitx, 150 m, 4.5.1986, M. MUS (hb. Mus). **MOROCCO:** Jebel Tazzeka, 1400 m, 22.4.1984, J.M. EGEA (MUB-9092, together with *R. trachytica*).

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MYCOTAXON

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DISCOSIA PETRAKII, SP. NOV.

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Abstract. *Discosia petrakii* - a new species of genus *Discosia* Lib. (*Coelomycetes*) found on dead leaves of *Ceratonia siliqua* L. (*Fabaceae*) in the islands of Madeira is described and illustrated.

During a taxonomic revision of genus *Discosia* Lib. (*Coelomycetes*) a herbarium specimen labelled "*Discosia ceratoniae* Speg." (unpublished name) received from Naturhistorisches Museum, Botanische Abteilung, Wien, Austria (N 17937 - W) was studied. The fungus found on dry leaves of *Ceratonia siliqua* L. in the islands of Madeira is a typical *Discosia* species belonging to Section 2 *Laurina* Vanev of the genus (Vanev, 1991). In the present paper a new species is described, illustrated and compared with two similar saprotrophic species *D. laurina* Cald. and *D. jordanovii* Vanev.

***DISCOSIA PETRAKII* VANEV, SP. NOV.** (Fig. 1).

Conidiomata pycnidialia, magna (450-720 µm diam.), subrotundata vel irregularia, angulata, discoidea vel globoso-complanata, solitaria vel confluentes, epiphylla, sparsa vel gregaria, nitido-nigra; ostiolis 60-130 µm diam., angularis, centralis, leviter elevatis, cellulis intensius coloratis cincto. Cellulae conidiogenae 11-15 X 2-3 µm, cylindricae vel obtuso-conicae, interdum ampulliformes, rectae vel leviter curvatae, hyalinae. Conidia 18.8-25 ($\bar{x}$=20.40; s=1.81) X 2.5-3 ($\bar{x}$=2.75; s=0.20) µm, holoblastica, angusto-fusoidea, plus minusve arcuato-curvata, dorsiventralia, apice fere angustata, basi truncata, 3-septata, ad septa non constricta, subhyalina, duae cellulae terminaliae parvae, fere triangulares, duae cellulae mediae magnae, fere aequilongae; appendiculae filiformiae, rectae vel leviter curvatae, hyalinae, proxime apicem basimque conidii formantur.

Typus: Madeira, in foliis emortius *Ceratoniae siliquae,* 1929, J. Baretto, ex Herb. Mus. Hist. Natur. Vindob. N 17937 (F. Petrak, Pilzherb. sub *Discosia ceratoniae,* W! - **holotypus**).

Conidiomata pycnidial, large (450-720 μm diam.), ostiolate, subcircular or irregular in outline, discoid or depressed-globose, epiphyllous, separate, scattered or gregarious, black, shiny; ostioles large (60-130 μm diam.), central, irregular, angular, slightly prominent, papillate, surrounded by a darker rim. Conidiogenous cells 11-15 X 2-3 μm, cylindrical, blunt-conical or flask-shaped, straight or slightly curved, hyaline. Conidia 18.8-25 ($\bar{x}$=20.40; s=1.81) X 2.5-3 ($\bar{x}$=2.75; s=0.20) μm, holoblastic, fusiform, tapered to the both ends, with a truncate base and an obtuse apex, dorsiventral, more or less arch-shaped, 3-euseptate, hyaline, two end cells very short, almost triangular, two middle cells nearly equal in length, much longer than the end cells; conidial appendages two, hair-like, unbranched, lateral, hyaline, arising just at the apical and the basal extremity of the ventral side of the conidium.

D. petrakii looks like *D. laurina* and *D. jordanovii* from the same section, but clearly differs from these species in the size of pycnidia and conidia (Table 1).

D. jordanovii, D. laurina and *D. petrakii* are typically mediterranean species of genus *Discosia* characterized by certain common morphological features - arch-shaped even falcate conidia and very large pycnidia and ostioles. The three species of that well differentiated morphological group are distributed only in the Mediterranean zone of Europe that indicating their common origin from that formative center.

Table 1. Comparative morphologic data of *Discosia jordanovii, D. laurina* and *D. petrakii*

Species	Diameter of pycnidia (μm)	Dimensions of conidia (μm)
D. jordanovii	100-245	11.3-15($\bar{x}$=13.33) X 2.5-3.3($\bar{x}$=2.88)
D. laurina	210-360	15-20 ($\bar{x}$=17.76) X 1.8-2.5 ($\bar{x}$=2.13)
D. petrakii	450-720	18.8-25 ($\bar{x}$=20.40) X 2.5-3 ($\bar{x}$=2.75)

ACKNOWLEDGEMENTS

The author wishes to thank the Curator of W Herbarium for the loan of the authentic material examined, as well as the National Scientific Foundation of Bulgaria for the financial support.

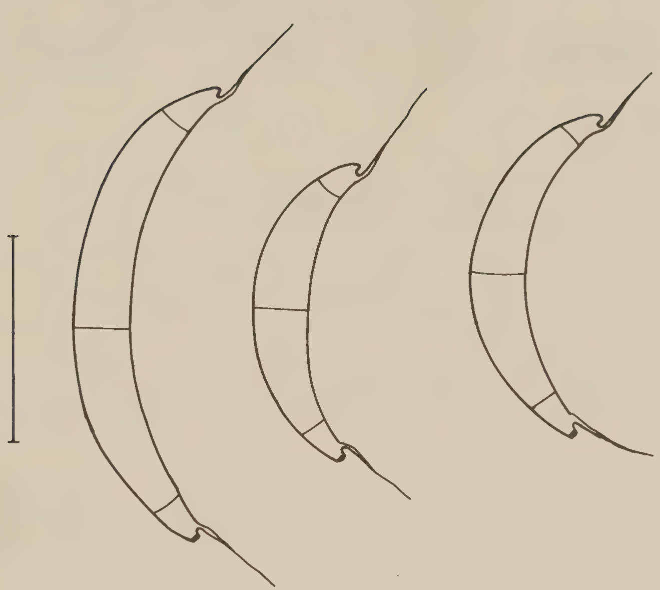

Fig. 1.Conidia of *Discosia petrakii.* Scale bar 10 μm.

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DISCOSIA ALBOFERRUGINEA, COMB. NOV.

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Abstract. A new combination *Discosia alboferruginea* is proposed for the parasitic fungus *Gloeosporium alboferrugineum* causing leaf spots on *Acer saccharinum* in Illinois, USA.

During the taxonomic revision of genus *Discosia* an authentic specimen of *Gloeosporium alboferrugineum* Ellis & Everh. was studied. The specimen was kindly provided by the Curator of the Mycological Herbarium of the New York Botanical Garden.

The species has been described by Ellis & Everhart (1898) who reported the following data in the original description: "Maculae rubro-brunneae, angulares, acervuli 100-150 µm diam., hypophylli, demum atri, conidia oblonga, 12-14 X 3-3.5 µm".

Later on, the same authors wrote: "A reexamination of specimens of this species (G. alboferrugineum) shows only *Discosia maculaecola* Ger., the sporules of which may have been mistaken for *Gloeosporium* spores, and if so the species must be abandoned" (Ellis & Everhart, 1900).

The quoted passage indicates that the authors suggest the name *Gloeosporium alboferrugineum* to be considered a synonym of *Discosia maculaecola.*

The comparative studies of the authentic specimens of *G. alboferrugineum* and *D. maculaecola* established that the parasitic fungus determined originally as *G. alboferrugineum* should actually be referred to genus *Discosia* but it differs substantially from *D. maculaecola* by its morphological and physiological features. The two species belong to different sections of the genus (Vanev, 1991) and parasitize on plants from different families which excludes whatsoever relation between them (Table 1). That fact gives reason to suggest the following new combination:

DISCOSIA ALBOFERRUGINEA* (ELLIS & EVERH.) VANEV, COMB. NOV.; *Gloeosporium alboferrugineum Ellis & Everh., Proc. Acad. Natur. Sci. Philadelphia: 371, 1894. **Type:** USA, Illinois, Peonia, on living leaves of *Acer saccharinum* L., Jul.14,1894, J. E. Mc Donald (NY! **Lectotype,** selected here).

Leaf spots variable in size (2-12 mm diam.), irregular, angular, single or sometimes confluent, red-brown to gray-brown, surrounded by a dark purple border. Conidiomata typically pycnidial, 90-180 µm diam., more or less circular in outline, discoid or depressed-globose, epiphyllous, separate, gregarious, black, shining; ostioles 17-35 µm diam., central, circular or sometimes irregular, slightly prominent, surrounded by a darker rim. Conidiogenous cells 5-12 X 1.5-2.5 µm, short, cylindrical, amoulliform or conical, straight or slightly curved, hyaline. Conidia 10-15 ($\bar{x}$=13.12; s=1.54) X 2.8-4 ($\bar{x}$=3.15; s=0.29) µm, holoblastic, mostly fusiform, sometimes cylindrical, tapered to the both ends, with a truncate base and an obtuse apex, straight or slightly curved, dorsiventral, clearly 3-euseptate, the two end cells thin walled, hyaline, the two middle cells almost equal in length, thick-walled, yellow-greenish; conidial appendages two, hair-like, single, unbranched, one-celled, hyaline, arising just at the apical and the basal extremity of the ventral side of the conidium.

Table 1. Comparison between *Discosia alboferruginea* and *D. maculaecola*

Species	Section	Length of conidia (µm)	Hosts
D. alboferruginea	*Laurina*	10-15 ($\bar{x}$=13.1)	on plants of Aceraceae
D. maculaecola	*Discosia*	14-20 ($\bar{x}$=16.5)	on plants of Smilacaceae

By its morphological features and parasitic specialization *D. alboferruginea* differs from all other specicies of Section *Laurina* known so far.

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The author wishes to thank the National Scientific Foundation of Bulgaria for the financial support of the investigations as well as the Curator of NY for the loan of the authentic material examined.

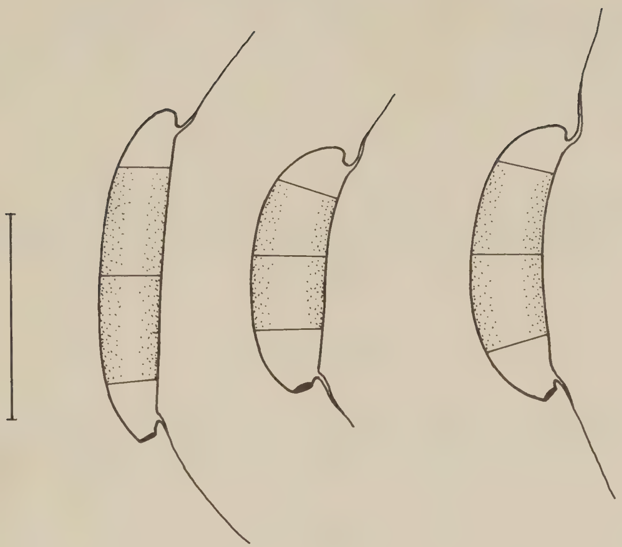

Fig. 1. Conidia of *Discosia alboferruginea.* Scale bar 10 µm

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FIVE NEW SPECIES OF AGARICALES FROM SOUTHERN AND SOUTHEASTERN YUNNAN, CHINA

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ABSTRACT

Five new species of Agaricales are described and illustrated from southern and southeastern Yunnan, China. Characters which separate the species from others are discussed. The new species are ***Gerronema chrysocarpum*, *Phaeomarasmius neoaffinis*, *Pyrrhoglossum yunnanensis*, *Phaeocollybia sparsilamellae*** and ***Crepidotus neocystidiosus***. All specimens cited in this paper have been deposited in the Cryptogamic Herbarium, Kunming Institute of Botany, Academia Sinica (HKAS).

During a recent investigation of the higher fungi in southern and southeastern Yunnan, China, 1442 collections were obtained. A number of species of Agaricales have been identified by comparing descriptions written in published books and papers or comparing type specimens. Among them five higher fungi are reported as new species in this paper.

Gerronema chrysocarpum P. G. Liu sp. nov.

(Figs. 1-5.)

Pileus 10-20 mm latus, convexus, interdum expansus, denique plus minusve umbilicatus, viscidus, glaber, cremeus usque luteolus, in sicco griseus, ad medium fuscus, striatis ad centrum fere attingens. Lamellae adnatae interdum parum concavae usque breviter decurrentes, arcuatae, cremeae vel flavae, margine luteae, in sicco aurantiacae, subdistantes, lamellulis. Stipes 50-70 mm longus, 2-3 mm crassus, cylindricus, aequalis, ad apicem albidus, ad basim brunneolus, fistulosus. Caro tenuissima. Sporae (6-)7-8(-8.5) X 4-5.5(-6) µm, ellipsoideae vel ovato-ellipsoideae, hyalinae, tenuitunicatae, uniguttulatae. inamyloideae, laeves. Basidia 17-22 X 7-8 µm, clavata vel cylindrica, 4-sporigera. Pleurocystidia 34-52 X 8-15 µm, dispersa, fusiformia vel ventricoso-lanceolata, hyalina, tenuitunicata. Cheilocystidia 34-48 X 7-12 µm, tenuitunicata, caespitosa, clavata usque late fusiformia, ad apicem obtusa interdum capitulatis vel minute protuerantis praedita, ochracea in KOH. Trama hymenophoralis regularis vel subregularis, hyphis 3-10 µm diam., hyalinis. Hyphae cuticulae pilei repentes, 4-8 µm latae. Hyphae carnis inflatae ad 4-24 µm diam., fibulatae.

Hab.: Gregarius vel caespitosus ad lignum carisum in silvis lithocarpi et castanopsis. Holotypus: Z-L Yang 1904 (HKAS 25900, Yunnan).

Pileus 10-20 mm diam., convex, sometimes expanding, finally slightly umbilicate, surface viscid, glabrescent, cream to yellow, becoming grey when dry, dark brown in the umbilicus, translucent striate almost to the disc. Lamellae adnate to shortly

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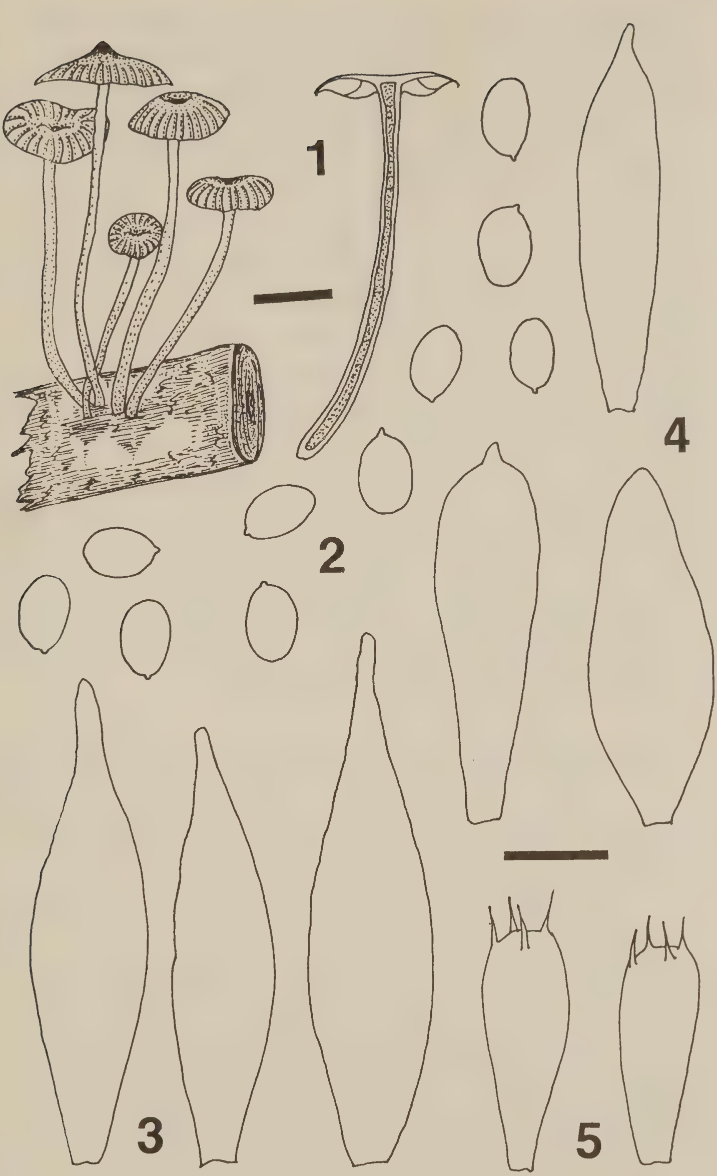
Figs.1-5. *Gerronema chrysocarpum*: 1. Habit and section (HKAS 25900). bar scale = 10 mm. 2. basidiospores. 3. pleurocystidia. 4. cheilocystidia. 5. basidia. Bar scale for Figs.2,3,4,5 = 10 µm.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decurrent, arcuate, cream to yellow, margin pale orange, becoming orange and with slightly reddish tint when dry, subdistant, with lamellulae. Stipe 50-70 mm long, 2-3 mm thick, cylindric, equal, surface whitish above, brownish below, fistulose, dry, glabrescent. Context membranous, whitish to pale orange. Spores (6-)7-8(-8.5) X 4-5.5(-6) µm, mean length of 60 spores in KOH 7.64 µm, mean breadth 4.87 µm of 60 spores (mean L/B ratio 1.57), ellipsoid or ovoid-ellipsoid, hyaline, thin-walled, uniguttulate, inamyloid, smooth. Basidia 17-22 X 8-15 µm, clavate to cylindric, bearing four sterigmata. Pleurocystidia 34-52 X 8-15 µm, numerous and scattered, fusiform or ventricose-lanceolate, hyaline, thin-walled. Cheilocystidia 34-48 X 7-12 µm, caespitose, clavate to broad fusiform, apex obtuse or sometimes with a capitellum or a small protuberance, pale ochraceous in KOH, thin-walled. Hymenophoral trama regular or subregular, hyaline, of parallel hyphae 3-10 µm diam., subhymenial layer interwoven, hyphae 4-8 µm diam. Pileal surface an undifferentiated cutis of subparallel hyphae 4-8 µm diam.. Hyphae of context inflated to 4-24 µm diam. with clamp connexions.

Specimen examined: Z-L Yang 1904 (HKAS 25900, Holotype), 5 July 1992, gregarious or caespitose on rotting wood in evergreen broad-leaved forest, alt. 2400 m; Daweishan, Pingbian County, Yunnan.

Note: The cream to yellow colours of the pileus and the lamellae, together with the presence of pleurocystidia, indicate that this species belongs in the sect. *Xanthophylla* Singer of the genus *Gerronema* Singer. The overall macroscopic appearance and habit closely approaches that of the African species *G. longipes* Pegler (Pegler, 1977; 1986), which differs in the absence of cystidia and the narrow ellipsoid spores (5.5-8 X 2.8-3.7 µm). At first glimpse *G. chrysocarpum* could be taken for the neotropical species *G. cheilocystidiatum* Sing., but the latter's cheilocystidia (14- 18 X 7-8.8 µm) and spores (4.5-6 X 3-3.5 µm) are smaller and pleurocystidia are absent (Singer, 1970a). The presence of pleurocystidia suggests that the infrageneric relationships of this species might be in the sect. *Fibula* (Singer) Sing., close to *G. fibula* (Bull.) Singer, but *G. fibula* differs in the slender basidiocarp, smaller spores and the absence of cheilocystidia (Singer, 1970a; Pegler, 1983).

Phaeomarasmius neoaffinis P. G. Liu, sp. nov.

(Figs.6-10.)

Pileus 23-50 mm latus, convexus dein concavo-expansus, brunneolus, squamellulis concoloribus dense obtectus, margine brevistriatus, siccus, plus minusve hygrometricus. Lamellae adnatae, pallide brunneae, margine albidae fimbriatae. Stipes 14-40 mm longus, 2-4 mm crassus, cylindricus, centralis, pileo concolor, cortina annulata instructus, infra annulum squamellulis recurvatis densioribus, basi tomentis flavidis obductus. Caro brunneola, tenuis. Sporae (5.5-)6-8 X (4-)5-6.5(-7) µm, late amygdaliformes, leviter multangulae, brunneae, crassitunicatae, laeves. Basidia 16-20 X 4.5-6 µm, (2-)4-sporigera. Pleurocystidia nulla. Cheilocystidia 28-44 X 10-16 µm, vesiculata vel clavata, hyalina, aggregata. Hyphae epicutis pilei terminaliter abreviatae, 18-26 X 6-16 µm, parietibus incrassatis. Hyphae fibulatae.

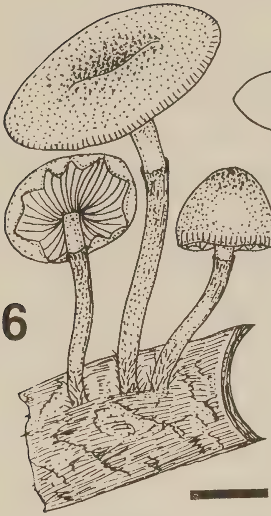
Hab.: Ad lignum cariosum in silvis lithocarpi et castanopsis. Holotypus: Z-L Yang 1781 (HKAS 25570); Paratypus: P-G Liu 1148, 1194, 1212 (HKAS 25571, 25572, 25584).

Pileus 23-50 mm diam., convex to semiglobose becoming concave-expanded, yellowish, disc covered with conspicuous, conic concolorous squamules, dry, slightly hygrophanous, margin with fibrillose to submembranous, fugacious remnants of the veil. Lamellae moderate crowded , adnate, pale brown, edge fimbriate. Stipe 14-40 mm long, 2-4 mm thick, cylindric to clavate, central, concolorous with pileus, fibrillose or covered with recurved squamules below persistent, membranous ring-like cortina, the base with white-yellowish tomentum, dry, stuffed. Context brownish, thin, odour and taste indistinct. Spores (5.5-)6-8 X (4-)5-6.5(-7) µm, mean length of 60 spores in KOH 6.56 µm, mean breadth of 60 spores 5.42 µm (mean L/B ratio 1.21), broadly amygdaliform, slightly multiangular, mucro present but indistinct, germ pore absent to indistinct, conspicuously thick-walled (about 0.3 µm thick), smooth, brown. Basidia 16-20 X 4.5 -6 µm, mostly 4-spored, occasionally 2 or 3-spored. Pleurocystidia none. Cheilocystidia 28-44 X 10-16 µm, vesiculose to clavate, slightly thick-walled, hyaline, numerous and crowded. Epicutis a trichodermial palisade, the terminal members of the hyphal chains usually shortened, thick-walled, 18-26 X 6-16 µm, mostly incrusted by yellow-brown pigments in KOH. Hyphae with clamp connexions.

Specimens examined: Z-L Yang 1781 (HKAS 25570, Holotype), 23 Jun. 1992; On rotten wood under forest of broad-leaved trees, alt. 1500-1950 m, Laojunshan, Malipo County, Yunnan; P-G Liu 1148, 1194 (HKAS 25571, 25572, Paratypes), 22, 24 Jun. 1992, same locality; P-G Liu 1212 (HKAS 25584, Paratype), 29 Jun. 1992, on rotten wood under forest of *Lithocarpus* spp. and *Castanopsis* spp., Gulingqing, Maguan County, Yunnan.

Note: The macroscopic characters of this species indicate a relationship to *P. affinis* E. Horak from Papua New Guinea (Horak, 1979). *P. neoaffinis* is well distinguished by thick-walled, somewhat multiangular spores and cuticular terminal hyphae with thick-walled, shortened elements.

Figs 6-10. *Phaeomarasmius neoaffinis*: 6. habit (HKAS 25570), bar scale = 10 mm. 7 basidiospores. 8. basidia. 9. cheilocystidia. 10. terminal elements of pileipellis. Bar scale for Figs. 7,8,9 = 10 µm. 11-12, *Pyrrhoglossum yunnannensis*: 11. habit (HKAS 25609), bar scale = 10 mm. 12. basidiospores, bar scale = 10 µm.



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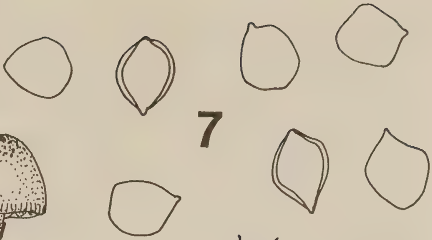

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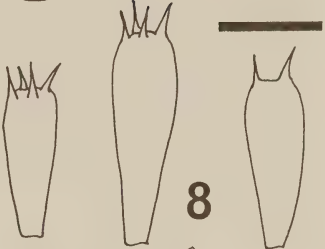

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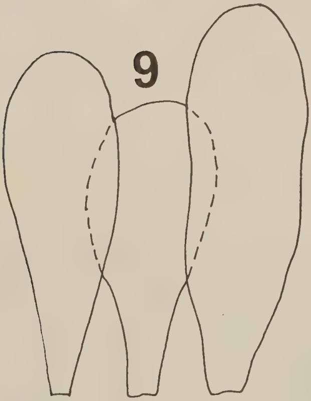

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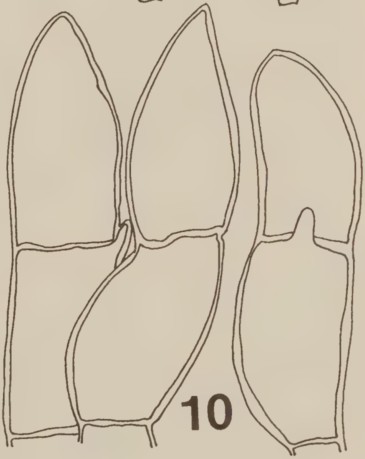

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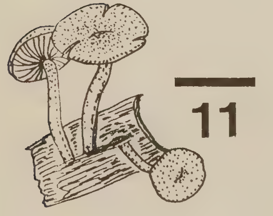

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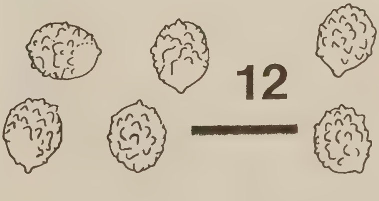

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Pyrrhoglossum yunnanensis P. G. Liu, sp. nov.

(Figs 11-15, 24.)

Pileus 6-14 mm latus, primum hemisphaericus, demum convexo-applanatus, hygroscopicus, non viscidus, aliquantum tomentosus, aurantiacus usque fulvus, margine undulatus et irregulariter lobatus. Lamellae ad stipitem adnatae, luteae usque fulvidae, confertae, margine pallidae, denticulatae, lamellulis. Stipes 8-12 mm longus, 1-1.5 mm crassus, fulvidus, centralis, interdum excentricus, cylindraceus, solidus. Caro pilei et stipis luteola, in sicco brunneola, ad centrum pilei circa 1 mm crassa. Sporae 6-7.3 X (4.5-)5-6.5 μm, ovoideae vel subglobosae usque breviter ellipsoideae, ferrugineae, conspicue verrucosae, crassitunicatae. Basidia 12-16 X 6-9.5μm, breviter clavata vel subcapitata, 4-sporigera. Pleurocystidia nulla. Cheilocystidia 18-26 X 5.5-8.5μm, clavata usque ventricosa, ad apicem capitata (5-6.5 μm lata), hyalina, tenuitunicata. Trama hymenophoralis regularis, luteola, hyphis 1.5-5.5 μm diam. Hyphae cuticulae pilei terminaliter plerumque ad 36-62 X 12-25 μm inflatae, flavobrunneae, ad parietem granulis pigmenti depositae in KOH.

Hab.: Ad lignum cariosum in silvis lithocarpi et castanopsis.

Holotypus: P-G Liu 1311(HKAS 25609, Yunnan).

Pileus 6-14 mm diam., semiglobose at first, then plane, hygrophanous, not viscid, somewhat tomentose on the surface, orange to fulvous, margin undulate and irregularly lobed. Lamellae adnate, yellow to fulvous, crowded, with lamellulae, margin pale, denticulate. Stipe 8-12 mm long, 1-1.5 mm thick, slightly excentric to central, surface concolorous with the pileus, cylindric, solid or stuffed. Context yellowish becoming

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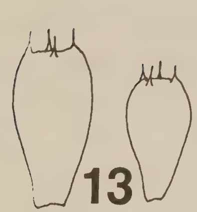
Figs.13-15. *Pyrrhoglossum yunnanensis*: 13. basidia. 14. cheilocystidia. 15. terminal dermatocystidioid elements of pileipellis. 16-17, *Phaeocollybia sparsilamellae*: 16. habit and section (HKAS 25531), bar scale=10 mm. 17. basidia and basidiospores. Bar scale for Figs. 13,14,15,17=10μm.



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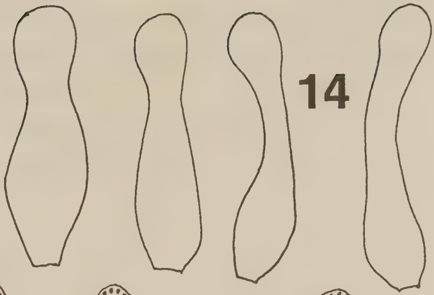

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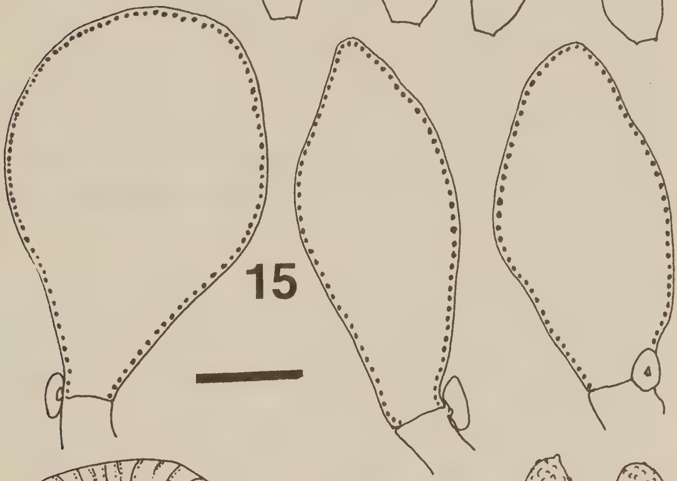

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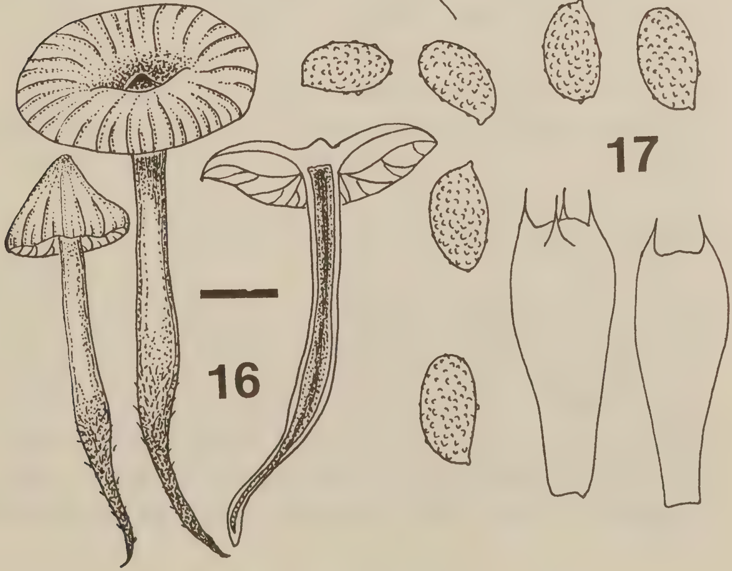

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brownish when dried, about 1 mm thick at disk. Spores 6-7.3 X (4.5-)5-6.5 µm, mean length of 60 spores in KOH 6.61 µm, mean breadth of 60 spores 5.4 µm (mean L/B ratio 1.22), ovoid or subglobose to short ellipsoid, ferruginous, distinctly verrucose, thick-walled. Basidia 12-16 X 6-9.5 µm, short clavate, bearing four sterigmata. Pleurocystidia absent. Cheilocystidia 18-26 X 5.5-8.5 µm, variform, mostly lecythiform with a clavate to ventricose base and with a capitellum (5-6.5 µm diam.) subtended by a narrow neck, hyaline, thin-walled. Hymenophoral trama regular, yellowish, with parallel hyphae 1.5-5.5 µm diam. Pileipellis an indistinct epicutis of interwoven, slightly agglutinated hyphae 3-10 µm diam., often with dermatocystidioid terminal elements 36-64 X 12-25 µm, with yellow-brown pigment granules deposited on the wall in KOH.

Specimen examined: P-G Liu 1311 (HKAS 25609, Holotype), 5 July 1992, scattered on rotting wood in a mountain rain forest dominated by *Lithocarpus* spp. and *Castanopsis* spp., alt. 1850 m, Daweishan, Pinbian County, Yunnan.

Note: This small species differs from the Latin American species *P. stiptatum* Singer and *P. lilacepes* Singer (Pegler, 1983) and other species (Pegler, 1986) in the presence of conspicuous dermatocystidioid terminal elements in the pileipellis and larger spores as well as lacking any lilaceous tints.

Phaeocollybia sparsilamellae P. G. Liu, sp. nov.
(Figs. 16-19, 25-28.)

Pileus 20-50 mm latus, primum hemi-globosus, demum planus, fuscescens usque ad atrofuscus plus minusve purpurascens, non viscidus, ad centrum concavus et acute papillatus, superficialiter parce striatus, margine parum involutus vel incurvatus. Caro pilei albida, ad centrum circa 2 mm crassa. Lamellae sparsae, fuscae, ad stipitem adnexae, lamellulis. Stipes 40-80 mm longus, 4-5 mm crassus, centralis, cylindricus,

fuscus, intus fistulosus, basi in pseudoradicatum gradatim decrescens, alba tomentosus. Sporae (7-)8-9.5(-10) X 4.5-6.5 µm, ellipticae vel ovoideae, ferrugineae, verrucosae. Basidia 24-30 X 8-9 µm, clavata, (2-)4-sporigera. Cheilocystidia 24-38 X 5-9 µm, saepe cylindracea, interdum apice subcapitata, hyalina, caespitosa. Pleurocystidia absenta. Hyphae epicutis pilei parallelae, 3-10 µm diam., leviter gelatinosae. Hyphae tramarum regulares, fibulatae.
Hab.: Ad terram in silvis lithocarpi et castanopsis. Holotypus: P-G Liu 1163 (HKAS 25531, Yunnan).

Pileus 20-50 mm diam. convex at first, then plane, slightly concave at center and with an acute papilla, sparsely striate on the surface, brown to dark brown, more or less with purplish tint, not viscid, margin slightly involuted to incurved. Context white, thin, 2 mm thick at the disk. Lamellae adnexed, brown to dark brown, very sparse, with shorter lamellulae, L=8-10, l=6-8. Stipe 40-80 mm long, 4-5 mm thick, central, cylindric or slightly swollen at the base, hollow, tapering into a deep pseudorhiza with white tomentum, brown to dark brown. Spores (7-)8-9.5(-10) X 4.5-6.5 µm, mean length of 40 spores in KOH 8.25 µm, mean breadth of 40 spores 5.28 µm (mean L/B ratio 1.56), elliptical to ovoid, ferruginous, verrucose. Basidia 24-30 X 8-9 µm, clavate, mostly 4-spored, occasionally 2. Cheilocystidia 24-38 X 5-9 µm, cylindrical, occasionally apex subcapitate, hyaline, caespitose. Pleurocystidia absent. Cuticle of pileus composed of cylindrical parallel hyphae 3-10 µm diam., slightly gelatinous, encrusted with brown pigment. Hymenophoral trama regular. Hyphae with clamp connexions.

Specimen examined: P-G Liu 1163 (HKAS 25531, Holotype), 22 July 1992, caespitose on soil under forest dominated by *Lithocarpus* spp. and *Castanopsis* spp., alt. 1600 m, Laojunshan, Malipo County, Yunnan.
Note: This species is well defined by a number of characters: the sparse striated pileus, few and scattered lamellae, hyphae

with clamp connexions, and large spores. These characters distinguish it from other species of the genus (Smith, 1957; Singer, 1970b; Smith and Trappe, 1972; Horak, 1974, 1976/1977; Guzmán, Bandala-Muñoz and Montoya-Bello, 1987).

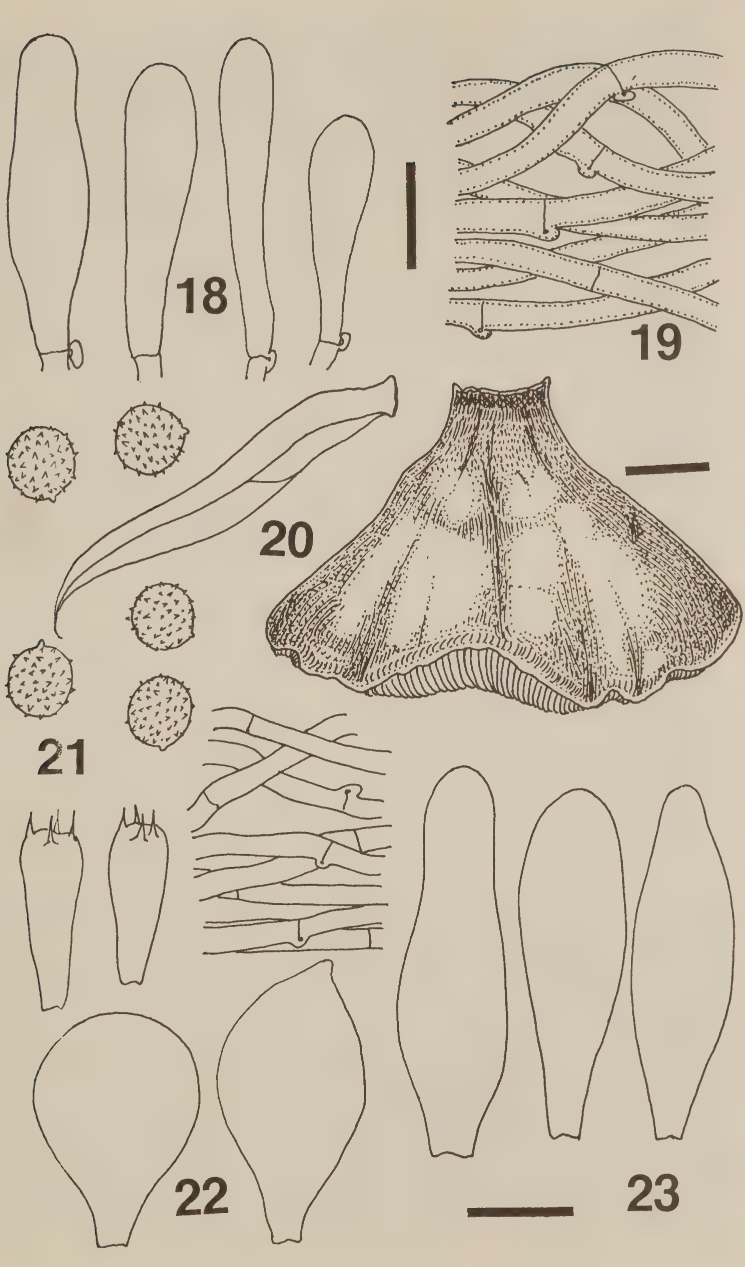
Crepidotus neocystidiosus P. G. Liu, sp. nov.
(Figs. 20-23, 29-30.)

Pileus 21-80 X 52-104 mm diam., siccus, lateralis, flabellatus, cremeus, postea griseo-ochraceus, margine leviter striatus, ad basim tomentosus. Stipe nullus. Lamellae moderate confertae, albidae, postea ochracea, lamellulis intermixtae. Sporae 5.5-7 µm diam., globosae, spinulosae, pallide argillaceae, inamyloideae. Basidia 14-18 X 6.5 µm, clavata, 4-sporigera. Cheilocystidia 22-36 X 10-14 µm, late clavata vel sublageniformia, hyalina, tenuitunicata. Pleurocystidia rarissima, 22-34 X 12-22 µm, napiformia vel capitata, brunneola, tenuitunicata. Trama hymenophoralis regularis, hyalina, haud gelatinosa. Hyphae carnis laxe intertextae, hyalinae, 5-17 µm diam. Tomenta pilei ex hyphis laxe intertextis 2.5-6.5 µm diam. constantia. Cuticula pilei ex hyphis 2.5-6 µm diam., hyalinis, dense reptantibus constantia. Hyphae omnes fibulatae.

Hab.: Ad lignum cariosum in silvis. Holotypus: Z-L Yang 1812 (HKAS 25566, Yunnan).

Pileus 21-80 X 52-104 mm diam., flabelliform, surface creamy to greyish ochre, margin straight, wavy, faintly striate, fibrillose, smooth and glabrescent except for a fibrillose tomentose region towards the base, lateral. Stipe absent.

Figs. 18-19. *Phaeocollybia sparsilamellae*: 18.cheilocystidia. 19. cuticle, bar scale=10 µm. 20-23. *Crepidotus neocystidiosus*: 20. habit and section (HKAS 25566), bar scale=10 mm. 21. basidiospores, basidia and cuticle; 22. pleurocystidia. 23. cheilocystidia. Bar scale for Figs. 21, 22, 23=10µm.



Lamellae radiating from a lateral point, moderately crowded with lamellulae, at first whitish, finally ochraceous, ventricose, edge entire. Spores 5.5-7μm, mean diameter of 40 spores in KOH 6.15μm in KOH, globose except for hilar appendix, with pallid clay-colored wall, distinctly echinulate, inamyloid. Basidia 14-18 X 6.5μm, clavate, bearing four sterigmata up to 3.5μm long. Cheilocystidia 22-36 X 12-22 μm, variform from broadly clavate to sublageniform, hyaline, thin-walled. Pleurocystidia usually rare, 22-34 X 12-22μm, napiform or capitate, with brownish contents in KOH, thin-walled. Hymenophoral trama regular, of thin-walled, hyaline, parallel hyphae 3.5-9μm diam., no gelatinization. Fibrillose tomentum towards the base consisting of loosely interwoven, thin-walled, hyphae 2.5-6.5μm diam. Pileal surface little differented from the underlying context, of densely repent, narrow and subparallel hyphae 2.5-6 μm diam., not inflated, lacking encrusting pigment. All hyphae with clamp connexions.

Specimen examined: Z-L Yang 1812 (HKAS 25566, Holotype), 23 Jun 1992, on rotting wood in forest, alt. 1550 m, Laojunshan, Malipo County, Yunnan.

Note: This species is characterized by its large size and solitary habit, pale lamellae, distinctly echinulate spores and napiform or capitate brownish pleurocystidia. It approaches closest to *C. cystidosus* Hesler et A. H. Sm. which lacks pigments but has a very short stipe and no pleurocystidia (Hesler and Smith, 1965). It resembles *C. nephrodes* (Berk. et M. A. Curtis) Sacc. in appearance and spores, yet differs in the pileal surface

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Figs.24-30. Scanning electron micrographs showing the shape, size or ornamentations of basidiospores of three new species: 24. *Pyrrhoglossum yunnanensis* (HKAS 25609). 25, 26, 27 & 28. *Phaeocollybia sparsilamellae* (HKAS 25531). 29 & 30. *Crepidotus neocystidiosus* (HKAS 25566). Bar scale for Figs.24, 28, 29 & 30 = 3μm; 26 & 27 = 4μm; 25 = 10μm.

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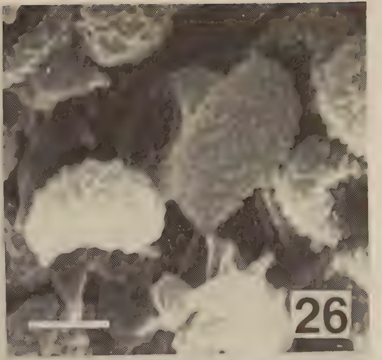
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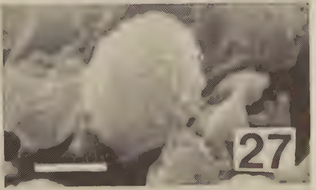
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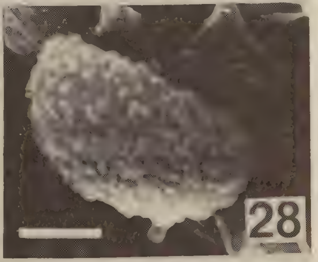
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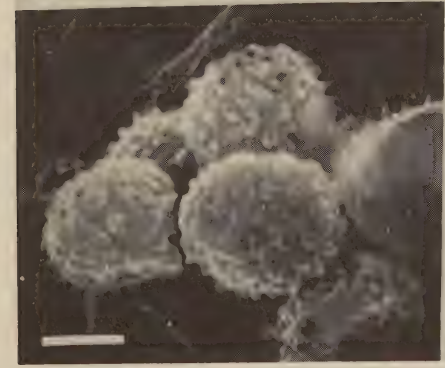

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anatomical characters, particularly the fibrillose tomentum consisting of fasciculate chains of short, ferruginous brown, thick-walled elements (Pegler, 1977; Natarajan and Raman, 1983).

ACKNOWLEDGEMENTS

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SMITH, A. H. and J. M. TRAPPE (1972). The higher fungi of Oregon's Cascade Head experimental forest and vicinity - I. The genus *Phaeocollybia* (Agaricales) and notes and description of other species in the Agaricales. Mycologia 64: 1138-1148.

汉文摘要

本文报道了产于中国滇南、滇东南伞菌目的五个新种，并讨论了相似种的区别特征。新种是金果老伞 *Gerronema chrysocarpum*, 新拟暗小皮伞 *Phaeomarasmius neoaffinis*, 云南火舌菌 *Pyrrhoglossum yunnanensis*, 疏褶暗金钱菌 *Phaeocollybia sparsilamellae*, 新囊靴耳 *Crepidotus neocystidiosus*. 文中引证标本存放于中国科学院昆明植物研究所隐花植物标本馆（*HKAS*）.

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POLYPORACEAE FROM ILHA DO CARDOSO, SP, BRAZIL

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ABSTRACT

A survey of the species of Polyporaceae from Ilha do Cardoso, SP, Brazil, (25°03'05"-25°18'18" S, 47°53'48" - 48°05'42" W) in its vegetation formations: rain-forest, "restinga", dune and mangrove. Thirty three taxa were identified and classified in 32 species and 19 genera. *Antrodiella angulatopora* Ryv., *Rigidoporus vinctus* (Berk.) Ryv. var. *cinereus* (Bres.) Setliff and *Tyromyces duracinus* (Pat.) Murr. are new records for Brazil. *Datronia stereoides* (Fr.) Ryv., *Earliella scabrosa* (Pers.) Gilbn. & Ryv., *Junghuhnia nitida* (Pers.:Fr.) Ryv., *Megasporoporia cavernulosa* (Berk.) Ryv., *Perenniporia neofulva* (Lloyd) Ryv., *Polyporus leprieurii* Mont., *Polyporus tricholoma* Mont. and *Trametes cubensis* (Mont.) Sacc. are new records from São Paulo State. The most abundant species were *Polyporus dictyopus* Mont., *Pycnoporus sanguineus* (L.:Fr.) Murr., *Microporellus obovatus* (Jungh.) Ryv. and *Antrodiella liebmannii* (Fr.) Ryv.

KEYWORDS: Polyporaceae, Basidiomycetes

INTRODUCTION

During the last years, several papers about the fungi of the island Ilha do Cardoso has been published (Bononi, 1979a, 1979b, 1979c, 1984; Bononi & Capelari, 1984; Bononi et al., 1984; Trufem, 1988, Capelari, 1989), but the only contribution to the knowledge of the Polyporaceae of the Island is that of Bononi (1979a, 1979c) who found two hydnoid species: *Hydnopolyporus fimbriatus* (Fr.) Reid. and *H. hartmannii* (Mont.) Reid.

Ilha do Cardoso is located in São Paulo State, Brazil, between 25°03'05"-25°18'18" latitude S, and 47°53'48" - 48°05'42" longitude W.

The island is lagerly mountainous, and the central region is dominated by a massif of over 800m, composed of metamorphic rocks (gneisses and micaschists) with magmatic outcrops (granite). Climate is affected by local factors, like humidity, topography, and vegetation. Its megathermic climate is superhumid, with no water shortage and considerable excess in summer; average annual temperature is 21.2°C (Barros et al., 1991).

All vegetation types occurring along the Brazilian coast are present in Ilha do Cardoso: pioneer dune vegetation, "restinga" vegetation, coastal plain rain-forest, Serra do Mar tropical rain-forest and mangrove (Noffs & Baptista-Noffs, 1982; Barros et al. 1991). "Restinga" is a complex of vegetation formations that show differences in physiognomy and are distributed in a mosaic in sandy plains. In Ilha do Cardoso, the "restinga"vegetation cover the most part of sandy plain, inside and in adjacents areas of pioneer dune vegetation (Barros et al., 1991).

MATERIALS AND METHODS

The fungi were collected during a period of two years, from January, 1990, to December, 1991, trying to cover the four seasons. The herbarium material deposited in the Herbario Científico Maria Eneyda P.K. Fidalgo (SP), in the Instituto de Botânica, was studied.

During the collections all vegetation types existing in Ilha do Cardoso (rain-forest, "restinga", dune and mangrove) were visited.

The material has been identified based mainly on Anell & Guzmán (1987), Bononi (1979a, 1979c), Corner (1981, 1984, 1987), Fidalgo (1968), Gilbertson & Ryvarden (1986, 1987), Ojeda-López et al. (1986), Overholts (1953), Pegler (1983), Ryvarden (1976, 1978, 1991), Ryvarden & Johansen (1980), Singer (1986), Teixeira (1993) e Wright & Deschamps (1975, 1976/77).

Genera and species are listed alphabetically with information on the local distribution.

RESULTS AND DISCUSSION

Thirty three taxa were identified and classified in 32 species and 19 genera :

Antrodiella angulatopora Ryv.
Mycotaxon 28 (2): 525, 1987.
(3 collections)
Antrodiella liebmannii (Fr.) Ryv.
Prelim. polyp. flora East Africa p.258, 1980.
(19 collections)
Datronia caperata (Berk.) Ryv.
Mycotaxon 23: 172. 1985.
(1 collection)
Datronia stereoides (Fr.) Ryv.
Flora over Kjuker, p. 42. 1968.
(2 collections)
Earliella scabrosa (Pers.) Gilbn. & Ryv.
Mycotaxon 22: 364, 1985.
(1 collection)
Fomitella supina (Sw.:Fr.) Murr.
Bull. Torrey bot. Club 32: 365, 1905.
(8 collections)
Gloeophyllum striatum (Sw.:Fr.) Murr.
Bull. Torrey bot. Club 32: 370, 1905.
(3 collections)

Hexagonia hydnoides (Sw.:Fr.) K. Fid.
Mem. N.Y. bot. Gdn. 17(2): 35-108. 1968.
(13 collections)
Hexagonia papyracea Berk.
Ann. Mag. nat. Hist. 10 (Suppl.): 379-380. 1843.
(2 collections)
Hydnopolyporus fimbriatus (Fr.) Reid
Persoonia, 2(2): 151-152. 1962.
(10 collections)
Irpex lacteus (Fr.:Fr.) Fr.
Elench. Fung. 1: 145, 1828.
(1 collection)
Junghuhnia nitida (Pers.:Fr) Ryv.
Persoonia 7 (1): 18, 1972.
(1 collection)
Megasporoporia cavernulosa (Berk.) Ryv.
Mycotaxon 16: 174, 1982.
(2 collections)
Microporellus obovatus (Jungh.) Ryv.
Norw. J. Bot. 19 (3-4): 232, 1972.
(20 collections)
Perenniporia neofulva (Lloyd) Ryv.
Mycotaxon 38: 83, 1990.
(5 collections)
Pleurotus ostreatoroseus Sing.
Publ. Inst. Micol. Univ. Recife 304: 10, 1961.
(4 collections)
Polyporus dictyopus Mont.
Ann. Sci. nat., Ser. 2, 3: 349, 1835.
(30 collections)
Polyporus guianensis Mont.
Ann. Sci. nat., Ser. 2, 13: 201, 1840.
(8 collections)
Polyporus leprieurii Mont.
Ann. Sci. nat., Ser. 2, 13: 203, 1840.
(10 collections)
Polyporus tenuiculus (Beauv.) Fr.
Syst. Mycol. 1: 344, 1821.
(12 collections)
Polyporus tricholoma Mont.
Ann. Sci. nat., Ser. 2, Vol. 8: 365, 1837.
(15 collections)
Pycnoporus sanguineus (L.:Fr.) Murr.
Bull. Torrey bot. Club 31: 421, 1904.
(25 collections)
Rigidoporus lineatus (Pers.) Ryv.
Norw. J. Bot. 19: 236, 1972.
(10 collections)

Rigidoporus microporus (Fr.) Overeem
Icon. Fung. malay. 5: 1, 1924.
(13 collections)
Rigidoporus vinctus (Berk.) Ryv. var. *vinctus*
Norw. J. Bot. 19: 139-144, 1972.
(2 collections)
Rigidoporus vintus var. *cinereus* (Bres.) Setliff:
Mycologia 64 (4): 689-701, 1972.
(1 collection)
Trametes cubensis (Mont.) Sacc.
Syll. Fung. 9: 198, 1891.
(14 collections)
Trametes elegans (Spreng.:Fr.) Fr.
Epicr. Syst. Mycol. p. 492, 1838.
(10 collections)
Trametes versicolor (L.:Fr.) Pilát
Atl. Champ. Eur. 3: 261, 1936.
(1 collection)
Trametes villosa (Fr.) Kreisel
Ciências Biol. Ser. 16: 84, 1971.
(6 collections)
Trichaptum sector (Ehrenb.:Fr.) Kreisel
Cienc. Biol. (Cuba), ser. 4, 16: 84, 1971.
(12 collections)
Tyromyces duracinus (Pat.) Murr.
N. Amer. Flora 9: 37, 1907.
(12 collections)
Tyromyces leucomallus (Berk. & Curt.) Murr.
N. Amer. Flora 9: 36, 1907.
(2 collections)

Rigidoporus vinctus var. *cinereus* and *Tyromyces duracinus* are new records from Brazil. *Antrodiella angulatopora*, *Datronia stereoides*, *Earliella scabrosa*, *Junghuhnia nitida*, *Megasporoporia cavernulosa*, *Perenniporia neofulva*, *Polyporus leprieurii*, *Polyporus tricholoma* and *Trametes cubensis* are new records from São Paulo State.

The best represented species were *Polyporus dictyopus*, *Pycnoporus sanguineus*, *Microporellus obovatus* and *Antrodiella liebmannii*.

This is the second report of *Perenniporia neofulva*.

All species are lignicolous and were found on logs or fallen branches of rotten angiosperms.

Only one species is a brown-rot fungus: *Gloeophyllum striatum*, the other species cause a white-rot. This results agree with Ryvarden (1991), who stated that the number of brown-rot species is low in the tropical zone (around 2% of the total wood-inhabiting basidiomycetes).

The specimens were most easily observed in the humid and hot period between October and May. Less specimens was collected between June and September, a dryer period with lower temperature.

Most fruitbodies were collected in the forest (61%) and "restinga" (23%), only a few specimens have been found in other envirомments; 9% transition between rain-forest and "restinga", 4% in mangrove and 3% in dune. The ocurrence of species of Polyporaceae in the vegetation formations in Ilha do Cardoso is represented in Table 1.

Table 1. Ocurrence of species of Polyporaceae in the vegetation formations in Ilha do Cardoso, SP, Brazil.

SPECIES	**RF**	**transition RF/R**	**R**	**M**	**D**
A. angulatopora	X				
A. liebmannii	X				
D. caperata	X				
D. stereoides	X				
E. scabrosa *					
F. supina	X	X	X		
G. striatum			X		
H. hydnoides	X	X	X	X	
H. papyracea	X	X			
H. fimbriatum	X				
I. lacteus			X		
J. nitida	X				
M. cavernulosa			X		
M. obovatus	X	X	X		
P. neofulva			X		
P. ostreatoroseus	X			X	
P. dictyopus	X	X	X		
P. guianensis	X				
P. leprieurii	X	X	X		
P. tenuiculus	X		X		
P. tricholoma	X	X	X		
P. sanguineus	X		X		X
R. lineatus	X	X	X		X
R. microporus	X	X	X		X
R. vinctus var. *vinctus*	X				
R. vinctus var. *cinereus*	X				
T. cubensis	X	X	X		
T. elegans	X		X	X	
T. versicolor	X				
T. villosa	X	X	X		
T. sector	X	X	X		
T. duracinus	X	X	X		
T. leucomallus	X				

* = on structural timber.

RF = Rain-forest R = "Restinga" M = Mangrove D= Dune

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MORPHOLOGY AND TAXONOMY OF BOLETUS QUELETII VAR. DISCOLOR, A RARE BOLETE RESEMBLING BOLETUS ERYTHROPUS

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Summary.- Boletus queletii var. discolor (Quél.) Alessio, a rare fungus, is described and commented upon; besides, a comparative study of its sporal parameters, with Boletus queletii var. queletii, B. queletii var. zugazae, B. queletii var. rubicundus, B. queletii var. lateritius and B. erythropus, is realized. The study confirms its taxonomic status as a variety of B. queletii.

INTRODUCTION

Boletus queletii var. *discolor* (Quél.) Alessio belongs to section *Luridi* Fr., a relatively well defined group in the genus *Boletus* L.: Fr. (cf. SINGER, 1986), in which several studies have been realized recently (e.g. ANDARY & al., 1992; TREU, 1993).

The purpose of this paper, besides realizing a taxonomic study on this rare bolete known exclusively from Bulgaria (KUTHAN & KOTLABA, 1981), France (COURTECUISSE & DUHEM, 1994; QUÉLET, 1888), Italy (ALESSIO, 1985), the Slovakian Republic (DERMEK & al., 1976), and Spain, is to stress that contrary to what is generally thought there are indeed useful microscopic characters in the genus *Boletus* which contribute to taxonomic classification.

Since its original description by QUÉLET (l.c.), this taxon has successively been considered as a variety of *Boletus luridus* Schaeff.: Fr. (QUÉLET, l.c.), a subspecies of *B. erythropus* Pers. (DERMEK & al., l.c.), a synonym of *B. junquilleus* (Quél.) Boud. (GILBERT, 1931), an independent species (BIGEARD & GUILLEMIN, 1909), a form of *B. queletii* Schulzer (e.g. BERTAUX, 1960; PARROT, 1964) or as a variety of *B. queletii* (ALESSIO, 1985).

The latter is due to the fact that species delimitation in the boletes, and consequently their taxonomy, has been largely based upon macroscopic features. Microscopic characters have been considered, generally, as having little importance, since they are very homogeneous among the majority of the taxa.

So species which are very similar microscopically may be very different from a macroscopical point of view. Characters such as size of basidiocarps, colours, etc. (though we must not overestimate their taxonomic value) are very important to separate one species from another. Experience shows us that, as happens in other genera such as *Cortinarius* (Pers.) Gray, it is absolutely indispensable to study this genus in the field.

Nevertheless, it is necessary to stress the importance of several microscopic characters whose taxonomic value has been assessed since some years ago. Reaction of all parts of the basidiocarps with Melzer's reagent should always be considered, as stated by some authors (e.g. HEINEMANN & RAMMELOO, 1982; TREU, l.c.), though others like ALESSIO (1985, 1993) do not attach much importance to this. Another important point is spore behaviour with this reagent. HEINEMANN & RAMMELOO (l.c.) indicated that no bolete is known with amyloid spores, but that in some species the latter are clearly dextrinoid. For this reason it would be necessary to test spores systematically for this reaction.

Furthermore, sporal parameters which are usually very homogeneous within this genus, may be studied with the help of statistical methods (cf. HEINEMANN & RAMMELOO, 1985), the latter being able to provide additional information for species delimitation.

In the present case of *Boletus queletii* var. *discolor* the study of both its sporal parameters and its behaviour with Melzer's reagent confirms the taxonomic status of this fungus as a variety of *B. queletii*.

In this work, besides giving a description of this taxon, a comparative study of the sporal parameters and their amyloidity (both from original material and bibliographic data) with other varieties of *Boletus queletii* and with *B. erythropus*, is realized.

MATERIALS AND METHODS

The microscopical observations, unless stated otherwise, were made in KOH 2% [according to BARAL (1992) higher concentrations may produce dramatic spore shrinkings, at least in many ascomycetes, contrary to what is commonly thought]. However, all parts of basidiocarps were also checked in Melzer's reagent.

The method followed to measure as well as to characterize the spores is the one proposed by HEINEMANN & RAMMELOO (1985). For this purpose I have always measured at least 20 mature spores lying on a hymenial mount of a mature specimen, and mean values ($\underline{X}$) of length (L), width (l) and Q coefficient (L/l), as well as their corresponding standard deviations (σ), were calculated with a spreadsheet (FW2). The values which are higher or lower than $\underline{x} \pm 2\sigma$ are quoted within parentheses.

The microphotographs have been realized with a Nikon microscope model Labophot, with automatic photographic system AFX-DX and phase-contrast, and with a Zeiss-950 SEM.

The material studied is kept at the herbarium of the University of Alcalá de Henares (AH).

RESULTS

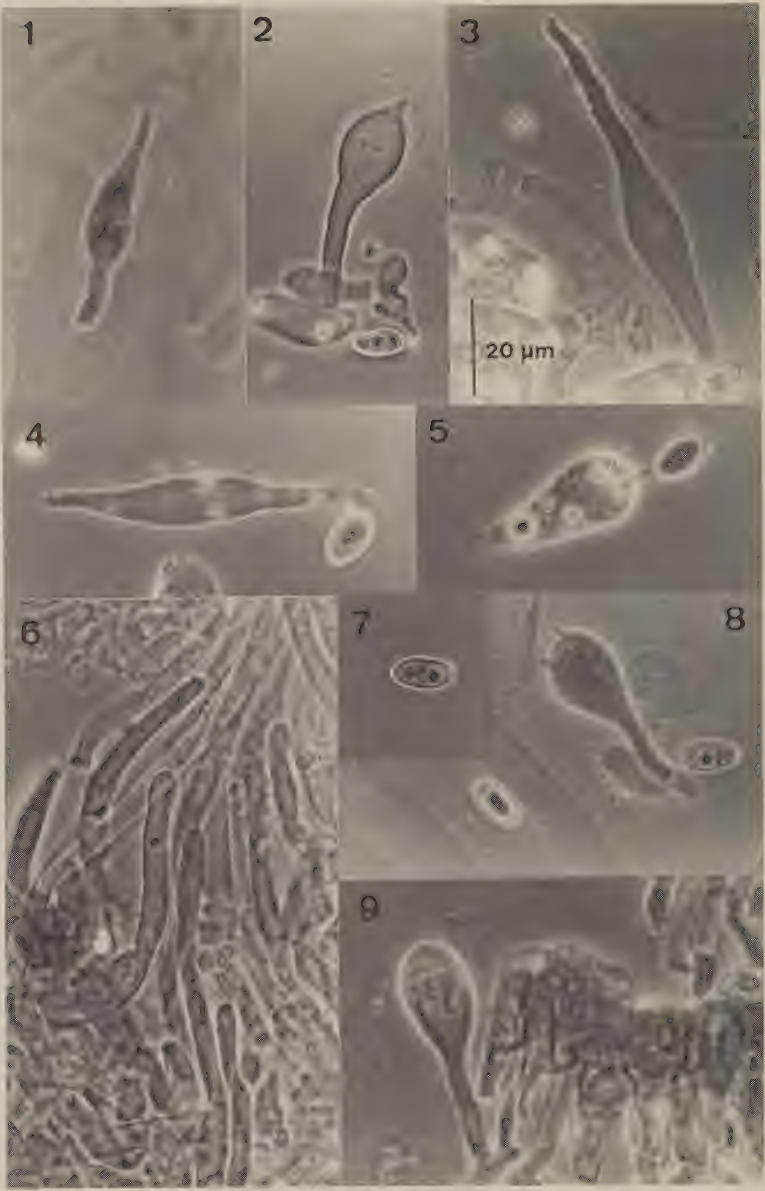
Boletus queletii* var. *discolor (Quél.) Alessio, *Fungi Europaei* 2: 193. 1985. (Figs. 1-13)
≡ *Dictyopus luridus* var. *discolor* Quél., *Flore Mycol. France*: 422. 1888.
≡ *Boletus discolor* (Quél.) Bigeard & Guillemin, *Flore Champ. Sup. France*: 382. 1909.
≡ *Boletus erythropus* ssp. *discolor* (Quél.) Dermek, Kuthan & Sing., *Ceská Mykol.* 30:1. 1976.

Original diagnosis of QUÉLET (l.c.): "Stipe jonquille, pointillé de granules rouge orangé, velouté et brun à la base. Peridium convexe plan, pruineux, puis lisse, jaune clair. Tubes jaunes; pores petits, rouge orangé, jaunes sous le bord du péridium. Été. Dans les forêts sablonneuses du centre et du nord de la France."

Description: Pileus up to 8,5 cm diam., semiglobose to convex at maturity, yellow to brown-yellow or olive-yellow, with slightly reddish shades at the margin, glabrous with the naked eye but fibrillose-tomentose under a lens. Tubes yellow, bluing strongly when cut or bruised. Pores orange-reddish (i.e. discolorous), but intermingled with yellow shades corresponding to the base colour of the tubes, bluing strongly when bruised. Stipe more or less cylindrical-clavate, up to 8,5 x 1,5 x 2,5 cm (basal part), the upper half being yellow and passing gradually into a brown reddish colour when descending to the base which is wine-red. The stipe is completely covered with a fine reddish to brown granulation, without any trace of a reticulum. Context yellow, bluing quickly and strongly, especially in the stipe. The basal part of the stipe context has a wine-red colour similar to the one on the outside.

Chemical reactions: with KOH 2%; pileus cuticle showing a purple-brown reaction; context in pileus showing a yellow-brown reaction.

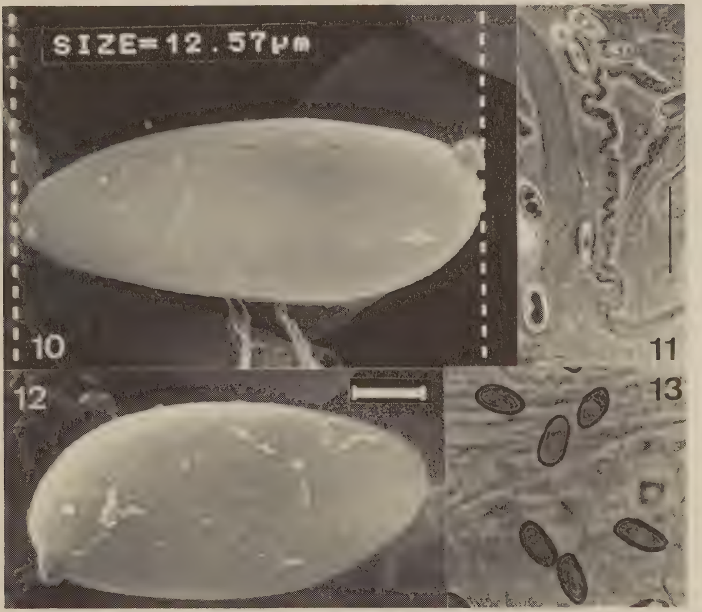
Spores fusiform to almost ellipsoid (a very high number of the latter is present), olivaceous to ochraceous in KOH 2%, smooth, 11,5-12,73-14,3(15,0) x 5,5-6,22-7,0 μm, Q = (1,64)1,73-2,05-2,25 (n = 22); spores in Melzer's reagent: inamyloid, apparently some of them with a small germ pore or callus but the latter being inconsistent under SEM, 11,1-12,34-13,5 x 5,5-6,18-6,8 μm, Q = 1,85-2,00-2,17 (n = 20). Basidia 29-36(45) x 11-14 μm, tetrasporic, clavate, hyaline, some of them with a yellow intracellular pigment, others with abundant vacuoles, clampless. Pleurocystidia 43-75(80) x 9-11,5 μm, variable in shape, fusiform to slightly lageniform or clavate to mucronate, some of them being gloeocystidia (=pseudocystidia s. Singer), with granular yellow intracellular pigment but with the same morphology and measurements. Cheilocystidia similar in size and shape to pleurocystidia (some of the cystidia present on the tube edges are pseudocystidia). All



Figs. 1-9, *Boletus queletii var. discolor* AH 15022; 1-4: pleurocystidia; 5: basidium; 6: pileipellis; 7: spore; 8: basidium and spores; 9: caulocystidia.

septa without clamp connections. Pileipellis a trichodermium, in some places a transition to a cutis, consisting of cylindrical hyphae without clamp connections, 3,5-6(9) µm in diam., some of them being ramified; vascular hyphae present, very refractive, rarely septate, irregular in outline, knobby, often coiled, with a yellow to ochraceous-brown intracellular pigment, sometimes also incrusted with a resinous matter. Caulocystidia 31-47 x 9-16 µm, variable in shape, utriform to lageniform or broadly clavate. Caulobasidia not observed. Context (tramal hyphae of both stipe and pileus) strongly amyloid with Melzer's reagent.

Material examined: Baides, 30TWL2035, in *Quercus rotundifolia* and *Juniperus thurifera* forest on basic (calcareous) soil, 30-IX-90, leg. J. Alvarez, M.N. Blanco, F. Esteve Raventós & M. Heykoop, AH 15022.



Figs. 10-13, *Boletus queletii* var. *discolor* AH 15022; 10 and 12: spores under SEM (bar = 2 µm); 11: vascular hypha (bar = 20 µm); 13: spores.

Comments: This taxon shows a closer relationship with *Boletus queletii* than with *B. erythropus*. With the former it shares the tramal amyloid reaction, the wine-red colour of the base of the stipe (both inside and outside) and the significantly lower Q coefficient than that of *B. erythropus* (see table 1). It differs from *B. queletii* because of the colours both of pileus and stipe, as well as through the dense granulation which completely covers the stipe; the latter brings it close to *B. erythropus*. Because of the absence of a reticulum on the stipe, the strong bluing of context and the yellow colours, this fungus can be confused in the field with a yellow form of *B. erythropus*.

A good illustration of this taxon has been published by ENGEL & al. (1983: 95). DERMEK & al. (1976) were the first authors to describe more or less accurately this taxon. They did however overlook some characters, such as the presence of vascular hyphae, the amyloid hyphae in the context (contrary to what they indicated) and the Q coefficient whose value is approximately 2. In any case, this taxon has never been illustrated microscopically.

Since the record of this bolete in my country in 1990, I went back regularly to the same locality, year after year, hoping to find it again, but without being successful. Besides, I have been looking for it in similar habitats and at different sites, with the same negative results. As for the commonness or rarity of this taxon I want to refer to MAY's (1988) article in which he indicates that "intuitive ideas about commonness and rarity usually make reference both to geographical distribution and to local abundance". According to this author, there are eight different categories, only one of them being the so-called common species, i.e. organisms with a broad distribution, unspecialized habitat and large populations. *Boletus queletii* var. *discolor* neither presents a very narrow distribution, as it occurs in different biogeographic areas (our material was collected in the Mediterranean region, though it also is known from the Eurosiberian one), nor a very wide one. This, together with a specialized habitat and very small populations, seems to define it as a fairly rare taxon. Apparently it is only distributed in Central and Southern Europe, in termophilous woods, forming ectomycorrhizal associations with *Quercus* species.

DISCUSSION

In view of Table 1 we can see that, in spite of a great sporal variability, the mean values remain more or less constant within narrow ranges. We can notice that mean values of the spore length of *Boletus erythropus* are higher than those of *B. queletii*, whereas mean values of sporal width are lower in the former and higher in the latter. This altogether leads to a mean Q coefficient that in *B. erythropus* is approximately 3, whereas in *B. queletii* it is approximately 2, which is quite significant. Besides var. *discolor* also has a mean Q value of approximately 2, which supports its relationship with *B. queletii* rather than with *B. erythropus*. So I conclude that this taxon is very closely related to *B. queletii*, though it resembles *B. erythropus*, and is best considered as a variety of the for-

TABLE 1. COMPARATIVE STUDY OF THE SPORAL PARAMETERS OF *Boletus erythropus*, *B. queletii* var. *queletii* , *B. queletii* var. *discolor*, *B. queletii* var. *lateritius*, *Boletus queletii* var. *rubicundus* and *Boletus queletii* var. *zugazae*

Boletus erythropus

AH 12782 (Majaelrayo, Guadalajara), L x l: 13,0-15,20-18,0(19,0) x 4,3-5,12-6,0 µm; Q = (2,64)2,68-2,98-3,28(3,44); n=24.
AH 13557 (Villares de Jadraque-Bustares, Guadalajara), L x l: 12,0-13,11-15,0 x 4,0-4,70-5,0 µm; Q = 2,55-2,81-3,21(3,22); n=21.
AH 13481 (Majaelrayo, Guadalajara), L x l: (12,0)12,3-14,68-17,0 x (4,5)4,6-4,99-5,3 µm; Q = 2,40-2,95-3,47; n=20.
AH 15076 (Cantalojas, Guadalajara), L x l: 12,0-14,14-15,5 x (4,2)4,4-5,07-5,7(5,8) µm; Q = 2,40-2,79-3,14; n=21.
AH 12783 (Majaelrayo, Guadalajara), L x l: 12,0-13,53-15,7(15,8) x 4,1-4,76-5,0 µm; Q = 2,56-2,85-3,16; n=20.
ENGEL & al. (1983), L x l: 12,0-18,0 x 4,0-6,5 µm; Q = ± 3,00.
BREITENBACH & KRÄNZLIN (1991), L x l: 14,0-16,6 x 4,7-5,9 µm; Q = 2,5-3,3.
ALESSIO (1985), L x l: 9,5-16,0 x 4,0-5,5 µm; Q not mentioned

Boletus queletii var. queletii

AH 12786 (Codes, Guadalajara), L x l: 9,0-11,19-13,7 x 5,0-5,99-7,5(8,5) µm; Q = (1,43)1,44-1,88-2,32(2,50); n=23.
AH 1244 (Barcelona), L x l: (9,0)9,8-11,54-13,0 x 5,0-5,96-6,9(7,0) µm; Q = 1,50-1,95-2,40; n=32.
ENGEL & al. (l.c.), L x l: (8,0)10,0-15,0(18,0) x (4,2)5,0-7,0(9,0) µm; Q = ± 2,00.
BREITENBACH & KRÄNZLIN (l.c.), L x l: 9,5-14,5 x 4,8-6,1 µm; Q = 1,80-2,60.
ALESSIO (l.c.), L x l: 12,0-16,0 x 4,5-6,0 µm; Q not mentioned.

Boletus queletii var. discolor

AH 15022 (Baides, Guadalajara), L x l: 11,5-12,73-14,3(15,0) x 5,5-6,22-7,0 µm; Q = (1,64)1,73-2,05-2,25; n=22.
DERMEK & al. (l.c.), L x l: 10,5-14,0 x 4,5-6,0 µm; Q not mentioned.
ENGEL & al. (l.c.), L x l: 10,5-14,0 x 4,5-6,0 µm; Q not mentioned.
ALESSIO (l.c.), L x l: 11,0-17,0 x 4,5-6,0 µm; Q not mentioned.

Boletus queletii var. rubicundus

MAIRE (1910), L x l: 8-10 x 4-5 µm; Q not mentioned.

Boletus queletii var lateritius

ALESSIO (l.c.), L x l: 12 x 5 µm; Q not mentioned.

Boletus queletii var. zugazae

AH 164 (Cercedilla, Madrid. Holotypus), L x l : 14,0-16,53-19,0 x 5,0-5,47-6,5(7,0) µm; Q = 2,67-3,03-3,45; n=29.
MORENO & BON (1977), L x l: 16,0-18,0(20,0) x 5,0-8,5 µm; Q not mentioned.

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mer, following ALESSIO (1985). Nevertheless, this author based his criterion mainly on macroscopic characters. He neither attached much importance to the taxonomic value of its amyloid hyphae, nor did he mention the coincidence of its Q coefficient with that of *B. queletii*. As we can see the characteristic macroscopic features of the taxon studied are now correlated with two important microscopic characters: viz. Q coefficient and amiloidity of stipe and pileus tramal hyphae, which coincide with those of *B. queletii*.

On the other hand, var. *zugazae* Moreno & Bon has values which differ considerably from those of *B. queletii*, having a mean Q value of approximately 3. Moreover, it shows an inamyloid context with Melzer's reagent, a character which definitely separates it from *B. queletii*. These data could point to a close relationship with *B. erythropus* from which it, however, greatly differs from a macroscopical point of view (MORENO & BON, 1977). Therefore *B. zugazae* maybe represents an independent species. Nevertheless, as I have never studied fresh material of this taxon I refrain from making the corresponding new combination.

Finally, var. *lateritius* (Bresad. & Schulzer) Gilbert and var. *rubicundus* Maire are variants which differ from *Boletus queletii* only in the cap colouring, a character which may be insufficient to warrant a varietal rank (WATLING, 1970). According to this author, var. *lateritius* differs in the more brick red cap and var. *rubicundus* in the carmine cap. Since I do not know these taxa I cannot give a reliable opinion.

According to SMITH & THIERS (1971) *B. pseudo-olivaceus* A.H. Smith & Thiers is closely related to *B. queletii*. However the latter has a Q mean value of ± 2 whereas the former has a Q mean value of 2,4. As stated by TREU (l.c.) further studies in this section are necessary which should include both the American and European taxa.

In relation to the bibliographic sporal data, only those of BREITENBACH & KRÄNZLIN (1991) are reliable as these authors applied a similar statistical method to the one used in the present study. As a result of the latter their data are almost identical with mine.

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MYCOTAXON

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A NEW EPIPHYTIC SPECIES OF THE LICHEN GENUS CALOPLACA FROM SOUTHWESTERN EUROPE

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ABSTRACT: *Caloplaca fuscoblastidiata* is newly described from southern Portugal and Spain. It is characterized by its isidiate to blastidiate thallus and dark brown apothecia.
A new combination, *Caloplaca oleicola* (Steiner) v.d.Boom & Breuss, is proposed.

KEY WORDS: Lichens, *Blastenia, Caloplaca, Caloplaca fuscoblastidiata, Caloplaca oleicola.*

INTRODUCTION

Since 1983, the first author has been studying the lichen flora of Portugal which resulted in a paper about lichens of northern and central Portugal (v.d.Boom et al. 1990). In 1993 he made many collections in the southern province Algarve. One epiphytic collection of *Caloplaca*, resembling *C. obscurella*, proved to be an undescribed species. One year after its discovery the second author collected material of the same *Caloplaca* species in southern Spain (prov. Cádiz). Information on the ecology of the new species is mainly based on field observations made by the first author at the type locality.

Caloplaca fuscoblastidiata v.d.Boom & Etayo sp. nov.

Thallus crustaceus, epiphloeodeus, continuus vel areolatus, griseus vel brunneo-olivaceus, K+ violaceus, 40-60 µm crassus. Blastidia numerosa, contigua, 50-150(-250) µm in diametro. Apothecia biatorina, abundantia, dispersa, sessilia, ad 0.8 mm in diametro. Disci plani vel convexi, brunnei. Hymenium 60-75 µm altum. Epithecium brunneum, K-, N-. Paraphyses 1.5-2.5 µm crassae, apicibus 2.5-5 µm crassis. Asci clavati, 35-55 x 10-12 µm, typo Teloschistes. Ascosporae octonae, 10-14 x 5.5-7 µm. Spermatia ellipsoidea, 3-4 x 0.8-1 µm.

Type: Portugal, prov. Algarve, N of Albufeira, 1 km N of Alte, near source, E slope along path, orchard with *Ceratonia siliqua, Olea europaea, Prunus dulcis* and calcareous outcrops, on *Ceratonia siliqua,* 8°10.8'W-37°14.5'N, alt. 400 m, 30 July 1993, leg. P.v.d.Boom 14942 (B holotype; isotypes in hb. v.d.Boom, hb. Breuss and hb. Etayo).

Thallus corticolous, crustaceous, epiphloeodal, continuous to areolate, forming irregular patches up to several cm in diameter, pale grey to olive greenish grey, mostly with olive brownish tinge, 40-60 µm thick, blastidiate; blastidia globular to club-shaped or cylindrical coralloid, sometimes flattened, 0.05 -0.15(-0.25) mm in diameter, scattered or dense and forming a thickish crust with more or less coralloid areolae (fig. 2); cortex with olive greenish or brownish, K+ violet pigment, N-. Photobiont green, coccoid, cells up to 5-14 µm in diameter. Apothecia numerous, dull to dark brown, slightly shiny, up to 0.8 mm in diameter, flat to slightly convex when mature; proper margin distinct, prosoplectenchymatous, brownish in outer part, thalline margin usually present and sometimes isidiate.

Epithecium brownish, lacking coloured crystals, K-, N-. Hymenium 60-75 µm tall, colourless. Hypothecium colourless. Paraphyses simple or often branched, 1.5-2.5 µm wide, swollen at apices, apical cells with a pale brown to dark olive brown cap, 3-5 µm wide (fig. 1). Asci 8-spored, clavate, *Teloschistes*-type, 35-55 x 10-12 µm. Ascospores ellipsoid, polarilocular, 10-14 x 5.5-7 µm, septum 4-6

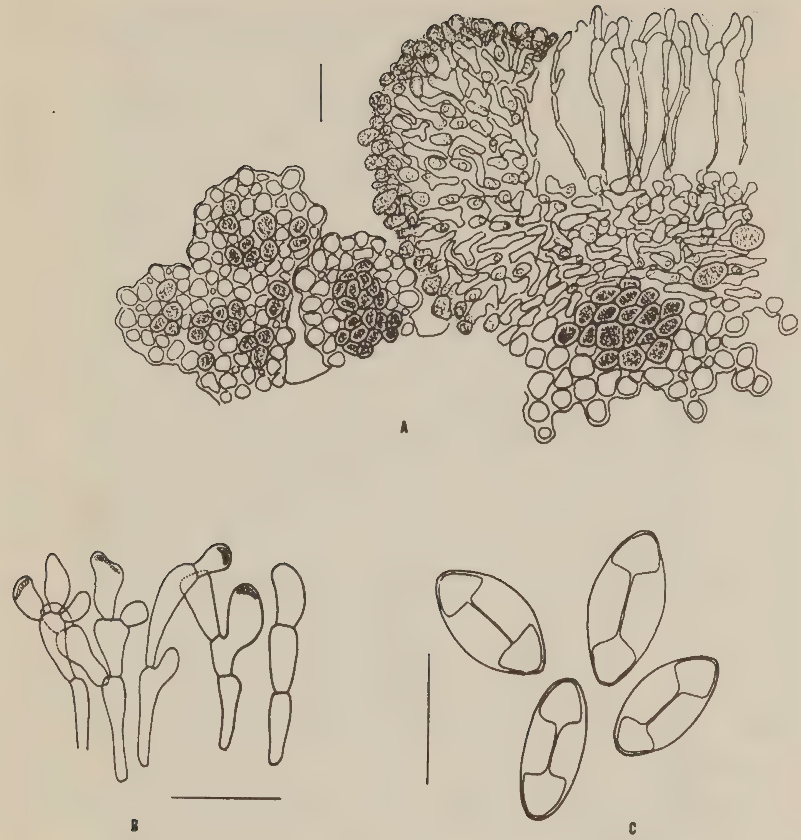

Fig. 1. *Caloplaca fuscoblastidiata* (holotype).
A: transverse section from an apothecium, with excipulum, paraphyses and blastidiate thallus. B: paraphyses. C: ascospores. Scale = 10 µm.

µm wide. Pycnidia olive blackish. Conidia ellipsoid to somewhat ovoid, 3-4 x 0.8-1 µm.

Ecology: *Caloplaca fuscoblastidiata* occurs on bark of trunks of old evergreen trees in southwestern Europe *(Olea europaea, Ceratonia siliqua & Quercus suber).* It seems to be a maritime species because all collecting sites are close to the sea (fig. 3). On the type locality it was found on two phorophytes, *Ceratonia siliqua* and *Olea europaea,* in a weakly sloping orchard with many scattered, very small to large limestone outcrops. This limestone was covered with a.o. *Caloplaca* and *Collema* species in sunny situation and with *Lepraria* spp. and *Squamarina* spp. on shaded surfaces. The terricolous lichen flora included *Catapyrenium semaforonense,* growing with *Psora decipiens.* Both phorophytes of *Caloplaca fuscoblastidiata* were mature trees which were found together with deciduous *Prunus dulcis* trees. On the latter trees *C. fuscoblastidiata* has not been found. Associated species on *C. siliqua* include *Bacidia laurocerasi, Buellia griseovirens* (fertile), *Caloplaca lucifuga, C. pollinii, Lecanora piniperda* (the latter on decorticated wood of trunk), *Pannaria olivacea, Peridothelia* cf. *fuliguncta, Pertusaria hemisphaerica* and *Schismatomma decolorans.* On *Olea europaea, C. fuscoblastidiata* was growing together with *Caloplaca obscurella, Collema multipartitum, C. nigrescens, Koerbera biformis, Rinodina dalmatica* and *Tephromela atra.* Accompanying species on shaded trunks of *O. europaea* in Spain are *Physconia distorta, Physcia tenella* and *Leptogium teretiusculum.*

NOTE

C. fuscoblastidiata may be confused with *C. herbidella,* when sterile, but the thallus of the former is always darker and, if well developed, distinctly blastidiate. *C. herbidella* has never been found with a blastidiate thallus. The apothecia of *C. fuscoblastidiata* resemble those of *C. obscurella,* but are more prominent and conspicuous and more abundant. Moreover, the latter species always has well-developed, minute, rounded, crater-shaped soralia. The new lichen is easily distinguished by the combination of blastidia and

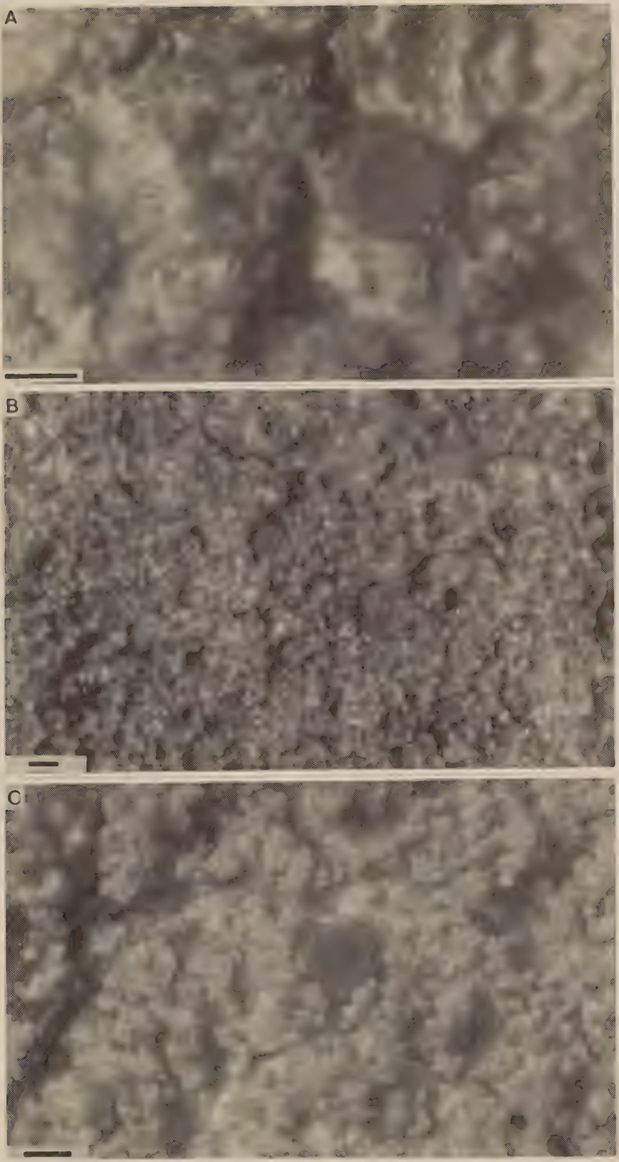

Fig. 2. *Caloplaca fuscoblastidiata* (Etayo 12196).
A: apothecium. B: blastidiate thallus and apothecia. C: blastidiate, areolate thallus and apothecium. Scale = 500 μm.

slightly shiny, dark brown apothecia.

Examination of herbarium specimens showed that *C. fuscoblastidiata* was collected frequently by Tavares in Portugal. He identified his material as *Caloplaca* sp., *C. sarcopisoides* or *C. refellens,* now considered as synonym of *C. obscurella* (Arvidson & Martinsson 1993). He did not publish his records of the *C. obscurella* group but he distributed an exsiccate: Lich. Lus. Sel. Exs. 244 as *"C. sarcopisoides".* According to Arvidsson & Martinsson (1993) this is not this species. Probably it belongs to *C. fuscoblastidiata.*
Descriptions of other related species like *C. squamulata* (Nyl.) Boistel or *C. suspiciosa* (Nyl.) H. Magn. do not refer to *C. fuscoblastidiata* (Dr. Gómez-Bolea saw type material of *C. suspiciosa).* Another poorly known species with dark apothecia, described from Italy, on *Olea europaea,* is *Blastenia oleicola,* of which the type collection was studied for comparison (see appendix).

Additional specimens examined: Portugal: Algarve, type locality, on *Olea europaea,* 30 July 1993, leg. P.v.d.Boom 14944 (hb. v.d.Boom, hb. Etayo 3455); Ibid. NE of Albufeira, road Benafim Grande to Salir, 3 km W of Salir, *Olea* orchard, 400 m, on *Olea europaea,* 30 July 1993, P.v.d.Boom 14363 (hb. v.d.Boom); Serra de Monchique, Caldas, sôbre o ritidoma de *Quercus suber,* 20 February 1946, C. Tavares 1378 (hb. Tavares); Ibid. sôbre o ritidoma de *Ceratonia,* 7 June 1952, C. Tavares 4810 (hb. Tavares); Ibid. Vale do Paraiso, junto Balnearios, 190-200 m, sôbre *Olea,* 25 February 1946, C. Tavares 1370 (hb. Tavares); Ibid. C. Tavares 1368 (hb. Tavares, det. H. Magnusson as *C. herbidella).* Spain: Andalucía, Cádiz, Jerez de la Frontera, Canuto del Caballo, road from Alcalá de los Gazules to Pto. Galis, Km 16, UTM30STF6347, 420 m, on *Olea europaea,* 18 April 1994, M. Casares, J. Etayo 12196 & 12197, A. Gómez-Bolea & N. Hladún (hb. Etayo).

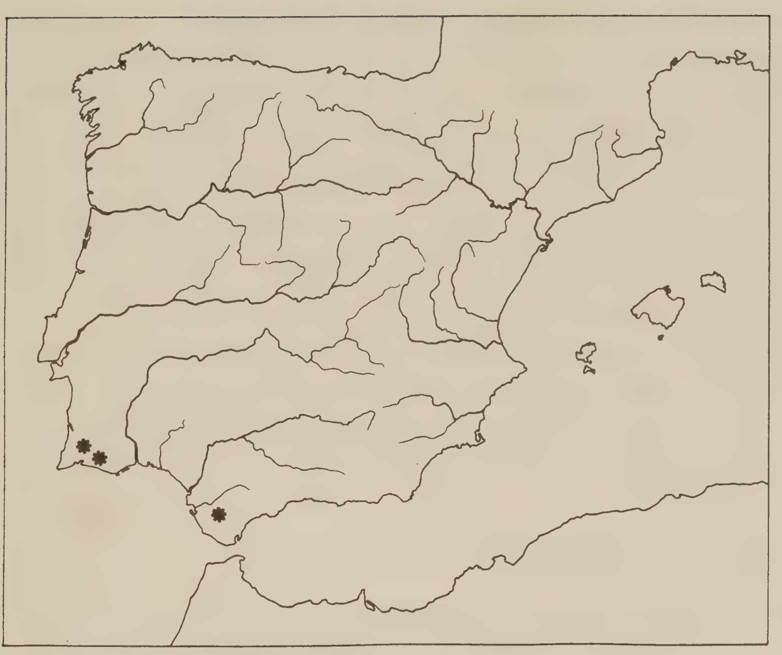

Fig. 3. Known distribution of *Caloplaca fuscoblastidiata.*

APPENDIX

Caloplaca oleicola (Steiner) v.d.Boom & Breuss comb. nov.

Basionym:
Blastenia oleicola Steiner, Verh. k.k. zool.- bot. Ges. Wien, 61: 61-62, 1911.
Type: Italy, Liguria, Rojatal, unterhalb Airole (WU-holotype).
The type collection, a single collection from *Olea europaea* from the borderline area with France, has been studied. The thallus is very thin, c. 60 µm, clear whitish, continuous to weakly rimose, esoredi-

ate, not distinctly delimited, thallus and medulla K -. Apothecia dispers, adpressed to sessile, up to 0.6 mm in diameter, black, disc weakly concave to plane or slightly convex. Excipulum dark violet-black at outer edge and K+ violet-red, internally yellowish. Hymenium 65-70 µm tall. Paraphyses filiform, richly branched, mid-hymenium cells 2-2.5 µm wide, sometimes slightly broadened towards the tips, apex up to 3(-3.5) µm wide. Epithecium dark brown, K+ violet-red. Asci 8-spored, clavate. Ascospores ellipsoid, polarilocular, 10-16 x 6-8 µm, septum c. 5 µm wide. Pycnidia black, immersed, relatively abundant, conidia cylindrical, c. 3 x 0.7 µm.

The only accompanying species which was found in the type collection in some small patches was *Hyperphyscia adglutinata*.

Caloplaca oleicola differs from *C. fuscoblastidiata* in many respects, the most obvious features being the very thin, white thallus and the black apothecia.

ACKNOWLEDGMENTS

We are grateful to Dr. O. Breuss and Dr. H. Sipman for comments on the manuscript and to Dr. A. Gómez-Bolea for providing us samples from herbarium Tavares and information on some species of *Caloplaca*. The second author is indebted to the DGICYT for the project PB89-0518-C02-01.

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MYCOTAXON

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LICHENS AND LICHENICOLOUS FUNGI OF THE QUEEN CHARLOTTE ISLANDS, BRITISH COLUMBIA, CANADA. 1. INTRODUCTION AND NEW RECORDS FOR B.C., CANADA AND NORTH AMERICA

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ABSTRACT

The Queen Charlotte Islands lie off the west coast of North America, and are characterized by a strongly oceanic climate, coniferous rain forest and rocky shores, with a low mountainous region rising to 1100 m.s.m. Its lichen flora is abundant and diverse, with numerous disjunctions and new taxa. Fifty-four crustose lichens and lichenicolous fungi are reported as new for British Columbia, among which six are new to Canada, and 18 are new to the North American flora. The new combination *Porpidia ochrolemma* (Vain.) Brodo & R. Sant. is made.

INTRODUCTION

A series of historical factors have made the Queen Charlotte Islands (or the "Charlottes," as I will often call them in these pages) a special place for biologists and geologists. The unusually high number of endemic and disjunctive plants and animals found there (see articles in Scudder and Gessler 1989) have given the islands the nickname, "The Canadian Galapagos" (Foster 1984). Because of endemisms and disjunctions already known there, the islands were made the object of an intensive study of the vascular plant flora in the 50's and 60's resulting in the Department of Agriculture's two-part publication entitled, "Flora of the Queen Charlotte Islands" (Calder & Taylor

1968; Taylor & Mulligan 1968). At about the same time, Dr. Wilfred Schofield, at the University of British Columbia, was working on a bryophyte flora of the Charlottes, to complement the work by Calder and Taylor. In 1966, Dr. Schofield suggested that I take up the study of the lichen flora so as to "round out" the floristic treatment. This, I gladly agreed to do and immediately made plans for my first field season on the islands. The work proved to be vastly more complicated than anyone could have guessed, and other projects prevented either Schofield or Brodo from completing the project as envisioned, i.e., "Part 3" of the Flora of the Queen Charlotte Islands. Schofield has published a number of papers dealing with the Queen Charlotte bryophytes (Schofield 1989, and references therein), but this is the first paper of a series based on my own work entirely devoted to the lichens of the Queen Charlotte Islands (QCI).

Because of the increased interest in the QCI and nearby Vancouver Island from the standpoint of conservation of shoreline habitats, preservation of virgin timberland and major centers of endemism (Islands Protection Society 1984; Goward 1994), the publication of the flora has taken on a degree of urgency. In addition, much activity is now occurring in southeast Alaska, especially in the Tongass National Forest, concerned with establishing baseline studies of lichens for monitoring air quality. No comprehensive treatment of the lichens of the northwest coast now exists, especially one dealing with the crustose lichens, and so there is no way for botanists, naturalists and other workers to identify the lichens they encounter in their work. Fortunately, Goward et al. (1994) have prepared identification keys and notes on all the foliose and squamulose lichens of British Columbia, and a similar work is being prepared for the fruticose species.

In this paper, and in the revisions to follow, references will be made to lichens in nearby coastal areas, especially Southeast Alaska[1] and Vancouver Island. For this reason, the historical treatment below will also cover those areas.

HISTORY OF LICHENOLOGY ON THE WEST COAST.

THE QUEEN CHARLOTTE ISLANDS.

Calder & Taylor (1968) provide a comprehensive history of botanical exploration on the QCI. The earliest collections of lichens of which I am aware were made by the amateur Canadian ornithologist and naturalist, William Spreadborough in 1910. The collection, now housed in the Canadian Museum of Nature (CANL), is not a large one, but includes some interesting records.

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[1] References to "Southeast Alaska" are roughly equivalent to Hultén's (1941) Eastern Pacific Coast District, the Alaskan "panhandle," approximately from Yukatat southeast, and encompassing the Juneau area, Sitka, Ketchikan, and the surrounding archipelago.

Herman Persson, a bryologist from the Swedish Museum of Natural History in Stockholm, Sweden, collected a large number of lichens, in addition to his bryophytes, on an expedition to the Charlottes in 1957. The lichens were sent to William Weber and Sam Shushan at the University of Colorado for identification, and this resulted in the first (and only) paper on the lichens of the Charlottes (Weber & Shushan 1959). I restudied all of this material, which is in Stockholm (S).

The peatland ecologist, Hugo Sjörs, visited the Queen Charlotte Islands in 1966. His collections were identified by Teuvo Ahti and deposited in the herbaria in Uppsala (UPS) and Helsinki (H).

Wilfred Schofield, the bryologist at U.B.C. has already been mentioned. In the course of his bryological explorations from 1961 on, Schofield collected many excellent lichen specimens now housed at the university herbarium (UBC). A large percentage of these have also been studied. Dr. Schofield and I did fieldwork together in 1967 and 1968.

Dale Vitt from the University of Alberta made some lichen collections on the Charlottes in 1975. These can be found at the U. of Alberta, Edmonton (ALTA).

Teuvo Ahti collected at Tasu and Sandspit in 1980, especially Cladoniaceae. His collections are in the University of Helsinki (H), with duplicates at CANL and UBC.

My own collecting activity on the islands is described under the Material and Methods section below. Observations and records based on this work have already appeared in some publications (Brodo 1971, 1973, 1977, 1984, 1988a, 1990, 1991, 1992, 1993; Vitt et al. 1973; Brodo & Hawksworth 1977; Brodo & Richardson 1978; Ahti et al. 1987; Brodo et al. 1987; Brodo & Hertel 1987; Tønsberg & Brodo 1992; Brodo & Wong 1993; Brodo & Tønsberg 1994).

SOUTHEAST ALASKA.

In Krog's (1968) treatment of the macrolichens of Alaska, one can find a detailed outline of lichenological exploration in Alaska, including activity along the southeast coast Some of the highlights are repeated below.

Most of the very early collections centered on the Bering Straits region, but some more southerly collections were also made by W.H. Dall, A. Kellogg, and T.H. Bean in the mid to late 1800's. Grace E. Cooley's collection in 1891, and those of Trelease and coworkers on the Harriman

Expedition of 1899 (treated by Cummings [in Cooley] 1892, and Cummings [in Cardot] 1904), are among the most important. James M. Macoun, the son of John Macoun, made a large number of collections in coastal Alaska between 1891 and 1901, and these are part of CANL in Ottawa.

In 1913 A.S. Foster collected lichens along the southeast coast, the results being published by Herre (1919) and Magnusson (1932). The Foster material was deposited in WTU or ORE. Thomson (1950) reported on the collecting efforts of W.J. Eyerdam, who also made important collections in northwestern Washington state.

Perhaps the most extensive lichen collections from southeast Alaska, especially of the macrolichen groups including the Cladoniaceae, were made by Hildur Krog during the 1950's (Krog 1968). She visited 14 localities in the Eastern Pacific Coast District and recorded 34 species of *Cladonia* and seven species of *Cladina* (if we treat some of her infraspecific taxa as full species). Some populations she regarded as "chemical strains" are recognized at the species level in our treatment. Krog's collections can be found at the University of Oslo herbarium (O).

In 1967 John W. Thomson and Teuvo Ahti made collections along the Haines Highway in Alaska and B.C. Most of their collections are reported in Thomson & Ahti (1994).

VANCOUVER ISLAND.

It was John Macoun, the first naturalist working for the Geological Survey of Canada, who introduced the Vancouver Island lichen flora to the world with extensive collecting efforts made in the area between Victoria and Sydney in the southeast corner of the island. These collections began in 1872 and continued for several years after his retirement, up to the year of his death in 1929. His lichens were sent to many of the most active lichenologists of that period. Many new taxa from Vancouver Island were published by G.K. Merrill (1913, 1914). Macoun's specimens have been widely distributed, but the first set is housed at the Canadian Museum of Nature (CANL).

In the 1950's, Adam Szczawinski made extensive collections from Vancouver Island as part of his study of the Douglas fir forest (Szczawinski 1953). The specimens are in UBC and the Royal B.C. Museum (V) in Victoria.

Willa Noble made the most thorough collection of Vancouver Island lichens in her study of the lichens of the Douglas Fir dry interior belt (Noble 1982). It is a great pity that this excellent treatment, including descriptions and keys to 448 species, was never published. A number of new and interesting records were, however, recorded in the B.C. lichen checklist (Noble et al. 1987) and in some shorter papers (Noble 1978, 1980; Ahti et al.

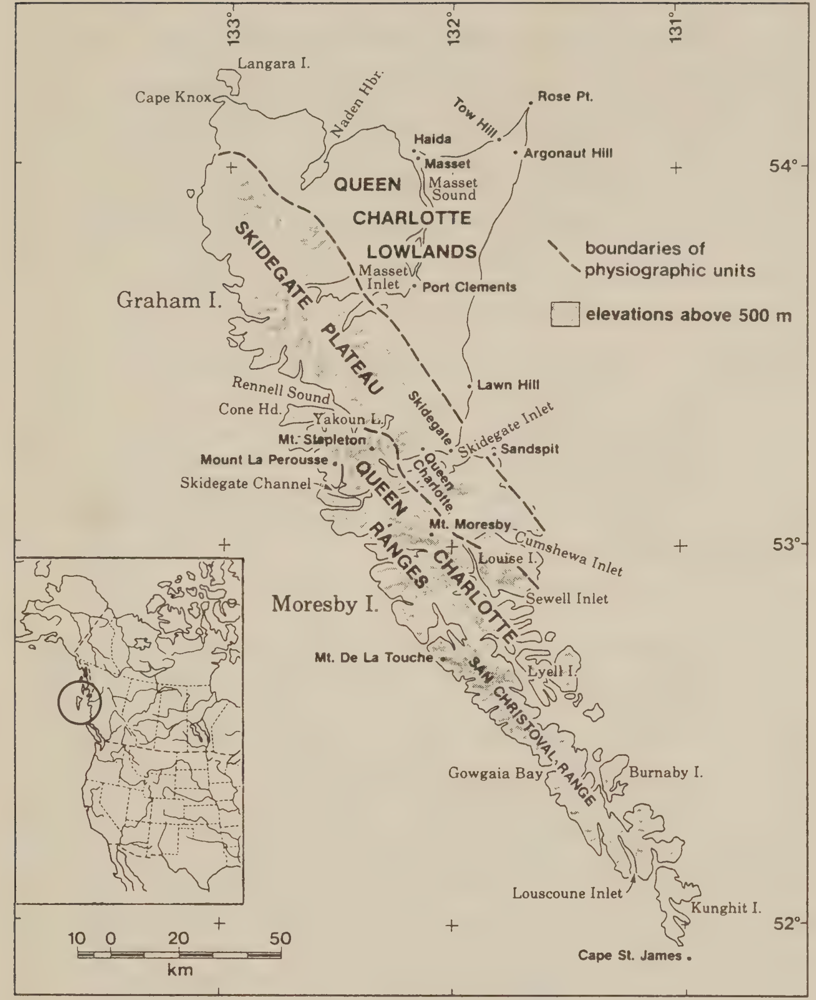


Fig. 1. Queen Charlotte Islands: natural physiographic subdivisions. Insert map shows the position of Charlottes on the west coast of North America. Modified from Sutherland Brown & Yorath (1989:19), with permission.

1987; Brodo et al. 1987).

In recent years, Vancouver Island and the adjacent Gulf Islands have been visited by other active lichenologists such as Trevor Goward of Clearwater, B.C., who collected ca. 2000 lichens in the Tofino-Ucluelet area in 1982; Tor Tønsberg (Bergen, Norway), who collected in numerous coastal localities from Washington to Alaska; and others. Some of their discoveries from the coastal localities have been published (Goward, 1984, 1988; Goward & Schofield 1983; Tønsberg & Goward 1992; Tønsberg 1992, 1993). Teuvo Ahti has collected there in 1958, 1961, 1977, 1980 and 1984; his first set of collections is in H.

GEOGRAPHY, CLIMATE AND VEGETATION

Accounts of the climate, general topography and flora of the QCI have been published by various authors in a variety of forms (e.g., Calder & Taylor 1968, Scudder & Gessler 1989, Islands Protection Society 1984). A summary is given below, however, to acquaint the readers with the general geographic setting.

GEOGRAPHY.

The Queen Charlotte Islands comprise an archipelago of 138 islands lying approximately 80 km off the British Columbia mainland coast. There are two main islands, Graham to the north and Moresby to the south, separated almost at the center by an east-west channel called Skidegate Inlet. The triangular archipelago is ca. 275 km long and, at its widest point, ca. 95 km across (Fig. 1). There is a rugged mountain range (the Queen Charlotte Mountains) running from the northwest corner of Graham Island to the tip of Moresby and Kunghit Islands dividing the Charlottes into a hypermoist west and relatively drier and flatter eastern region (the Queen Charlotte Lowlands). The Skidegate Plateau on Graham Island is somewhat less rugged than the Queen Charlotte Ranges, where the highest peaks (e.g., Mt. Stapleton and Mount La Perousse on Graham Island, and Mt. Moresby and Mt. De La Touche on Moresby Island) are over 1100 m. The spectacular San Cristoval Range, forming the southern sector of the Queen Charlotte Range on southern Moresby Island, is characterized by knife ridges, sheer rock walls up to a hundred meters high, and isolated cirque valleys and lakes. It is in these ranges that some of the most interesting endemic and disjunct taxa occur (Brodo 1993).

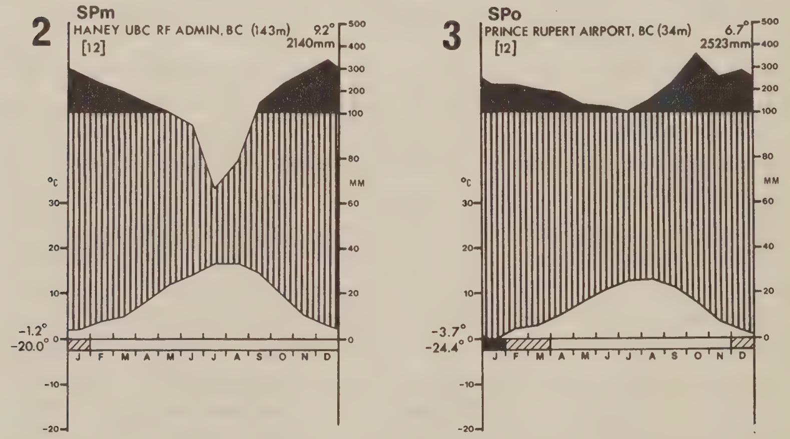
The coast line on the Pacific side is extremely rugged, with high, rocky headlands and long fiords (though none as long as one encounters on the mainland). The coastal rocks, like the mountain tops, have an important near-endemic and disjunct lichen flora (Brodo 1993). The eastern shores of Graham Island and northern Moresby Island, by contrast, are relatively low, with rounded hills and ridges never exceeding 150 m.s.m. From Louise Island southward, the San Cristovals extend from east to west producing fiords on both coasts. On Graham Island, the eastern and northern shores are mainly sandy and low with infrequent inlets. The interior is dotted with large and small boggy lakes, especially on Graham Island, with much exposed rock. River mouths are gravelly and often have broad beaches or deltas.

Southerland-Brown and Yorath (1989) present a detailed summary of the geological events that shaped the QCI. The following brief description is based mainly on that article. The parent materials on the Charlottes originated, for the most part, from three periods of volcanic activity beginning about 230 million years B.P., interspersed with relatively short periods of sedimentary rock formation under marine conditions. The volcanic rocks differ a great deal in chemistry, some being derived from deep in the mantle and rich in metals, and others derived from a melting of the upper continental crust, rich in alkalis and silica and poor in heavy metals. Through faulting and subsequent erosion, a variety of rocks have become exposed, and others have been overridden with more recent superficial deposits during the Tertiary and Quaternary Epochs, especially in the northeast.

The extreme vulcanism of the area is the result of the Charlottes lying on a fragment of the tectonic plate adjacent to the subduction zone where the Pacific plate is thrust under the North American continental plate. The Charlottes themselves, together with Vancouver Island and parts of adjacent B.C. and northern Washington, were not formed where one finds them today. Parts of the Alexander Archipelago making up the present-day southern portions of southeast Alaska were also built on an independent and remote crustal plate fragment. The two fragments (called "terranes") drifted to the north and east over a period of more than 100 million years, first colliding with each other about 140 million years B.P., and finally "docking" with the North American continent at its present latitude about 100 million years B.P. It is believed that the major rock formations forming all but the northeast corner of the Charlottes came into being about the latitude of present-day Peru (Southerland-Brown & Yorath 1989).

CLIMATE.

Lying in the center of the Pacific rim area affected by moist, onshore winds, the Aleutian low pressure, and North Pacific high pressure centers, and with a string of relatively high mountains running north-south, the Queen Charlottes receive an abundance of rainfall throughout much of the year. These conditions have resulted in a true oceanic climate (mild, very wet winters and cool wet summers), and the growth of one of the worlds most magnificent temperate rain forests. The climate differs significantly on the ocean and inland side of the Queen Charlotte Mountains. On the west coast, the warm, moist air from the ocean is forced up by the mountains where it cools and releases its moisture in the form of rain (ca. 3000-4000 mm/year). In the recent Ecoclimatic classification of Canada (Ecoregions Working Group 1989), the western sector of the Charlottes falls into the "Oceanic South Pacific Cordilleran" (SPo) region (Fig. 2). East of the mountain range, the air is much drier and precipitation is less frequent, especially between May and September, and rainfall is not much above the average for Canada (ca. 1000-1500 mm/year). Reflecting these differences, the eastern sector of the islands is classified as "Maritime South Pacific Cordilleran" (SPm) (Fig. 3). Temperatures, by contrast, are quite similar on all parts of the islands at the same altitude. During the winter, frosts are common, even at sea level, but are never prolonged, and there is little snow except in the mountains, where it can be extensive. (Much of the above information comes from Williams, in Calder & Taylor 1968.)



Figs. 2-3. Climate diagrams of the two major climatic subdivisions represented on the QCI. From Ecoregions Working Group (1989), with permission. - 2. Maritime South Pacific Cordilleran Ecoclimatic Region **(SPm)**, dominating the eastern 2/3 of the islands. - 3. Oceanic South Pacific Cordilleran Ecoclimatic Region **(SPo)**, ca. 25-30 km wide Pacific-facing fringe. Diagram: top curve: average monthly precipitation (mm) [reduced to 1/10 for values >100, in solid black]; lower curve: average monthly temperature (°C); vertically shaded area: period of relatively humid climate; upper right-hand corner: average annual temperature and precipitation.

MATERIAL AND METHODS

The list of lichens is based mainly on my own collections on the Queen Charlotte Islands. I visited the Charlottes during the summers of 1967, 1968, 1971 and 1988, collecting over 5000 lichen specimens representing all groups. In 1967, I was assisted by Mike Shchepanek, and in 1971 by Pak Yau Wong. In 1988, I was accompanied by photographers Stephen and Sylvia Sharnoff, and by entomologist (and wife), Fenja Brodo. I also participated in the 1980 excursion to the QCI as part of the International Congress of Systematic Biology meetings and collected additional material. Travel on the islands was by chartered boat (circumnavigating the archipelago several times over three seasons), by truck over paved public roads and unpaved logging roads, especially on Graham Island, by fixed wing aircraft to the larger bodies of water, and, in 1988, by helicopter to some of the higher mountainous localities in Moresby Island, as well as some coastal localities missed in earlier expeditions. I made major collections at 131 localities on 15 islands of the archipelago (Fig. 4). The first set of my lichens are at CANL. Duplicates have been distributed to many herbaria, especially as part of *Lichenes Canadenses Exsiccati* (Brodo 1971, 1977, 1984; Brodo & Wong 1993).

NEW RECORDS FROM THE LICHEN FLORA OF THE QUEEN CHARLOTTE ISLANDS, B.C.

In the following list, nomenclature and authorship basically follow Egan (1987, 1989, 1990, 1991) with some modifications based on Purvis et al. (1992) and Santesson (1993). I have checked original literature in cases of conflict wherever possible. Author abbreviations are in accordance with Brummitt and Powell (1992). Genera placed in quotation marks reflect a present classification that I regard as probably incorrect. No taxonomic changes are being proposed in this list, however.

New records for North America (**in bold-face**), Canada (underlined) and British Columbia (*simple italics*) are accompanied by citations of at least one specimen, deposited at the Canadian Museum of Nature (CANL). Further comments on the new records are kept to a minimum here because the taxa will be discussed in greater detail, and in context, in forthcoming revisions of taxonomic units within the Charlotte flora. All the new records are of crustose lichens. It is obvious that a great deal of work on the crustose lichen flora of North America is needed before the true biotic diversity of this important group of organisms is appreciated.

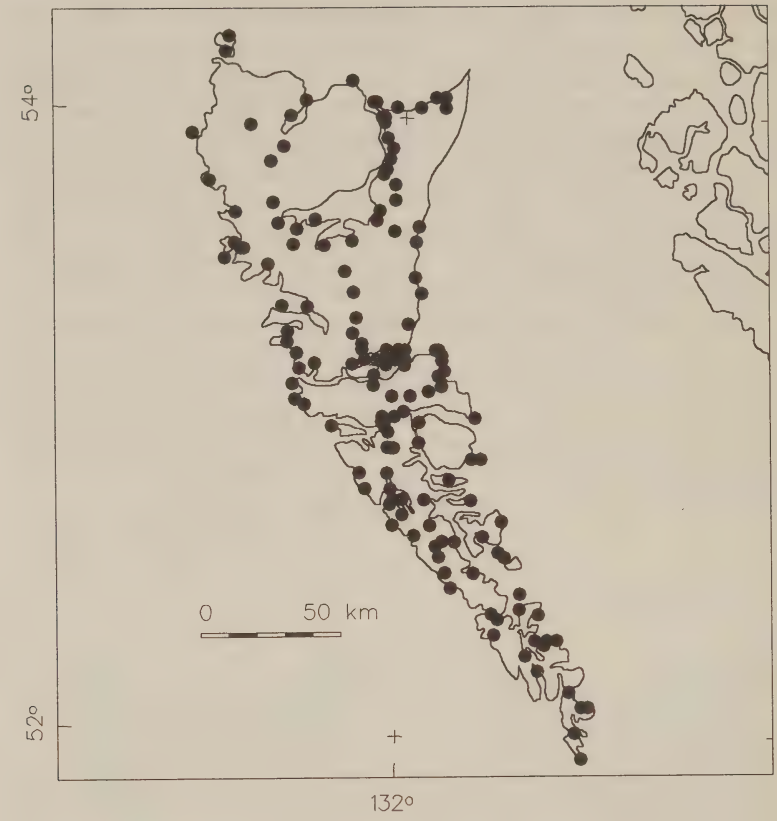


Fig. 4. Localities on the Queen Charlotte Islands at which major collections were made by the author.

There has been recent interest in documenting the rare or endangered lichens of British Columbia (e.g., Goward 1993). In this context, most if not all of the new records for North America listed here fall into the broad (unclassified) category of "rare." The new records for B.C. generally represent species that are rare in the province. It is interesting, therefore, that some lichens found on the Queen Charlotte Islands in abundance are quite rare elsewhere. Some examples include *Coccotrema maritima, Caloplaca litoricola, "Lecidea" phaeops* and *Amygdalaria subdissentiens.* Some of these species are good candidates for possible *in situ* survivors of the Pleistocene glaciations. These and other phytogeographic questions will be discussed in forthcoming papers.

The list of new records is as complete as it can be at this point in time, but studies of the Queen Charlotte lichen flora are continuing, and changes and additions are likely (especially in the genera *Usnea, Pertusaria, Verrucaria*, *Caloplaca*, and some pyrenocarpous and sterile crustose groups). A number of new species will be described in future papers, and these, of course, will add even further to our growing knowledge of the lichens of western North America.

Acarospora sinopica (Wahlenb. in Ach.) Körb.

MORESBY ISLAND: Takakia Lake, 52°56'N, 132°04'W, bluffs, outcrops and forests along the north side of the lake, on vertical face of cliff, elev. 590-640m, 6 July 1967, *Brodo* 11015B.

***Arthonia apatetica* (A. Massal.) Th. Fr.** (Syn. *A. exilis* auct.)

GRAHAM ISLAND: 2 mi. W of Tow Hill (Yakan Point) on north shore, 54°04'N 131°50'W, 15 June 1967, *Brodo* 9896R.

Coppins (1989) discusses this species with respect to *A. muscigena* Th. Fr. (sub *A. leucodontis* (Döbbeler & Poelt) Coppins).

***Arthonia muscigena* Th. Fr.** (Syn. *Bryostigma leucodontis* Döbbeler & Poelt in Poelt & Döbbeler, *Arthonia leucodontis* (Döbbeler & Poelt in Poelt & Döbbeler) Coppins; *Catillaria melanobola* f. *frullaniae* de Lesd., *Arthonia exilis* auct. non (Flörke) Anzi).

GRAHAM ISLAND: 2 mi. W of Tow Hill (Yakan Point) on north shore, 54°04'N 131°50'W, on exposed dead spruce tree on protected side of beach, 15 June 1967, *Brodo* 9896 I.

This inconspicuous lichen has apothecia under 0.2 mm in diameter. It has received much attention in the literature under a variety of names (see synonymy above; Poelt and Döbbeler 1979; Coppins 1983, 1989). The identity of *Bryostigma leucodontis* with *Arthonia muscigena* was pointed out by Santesson (1993). The Th. Fries type, which I saw in UPS, is virtually identical, but is on moss, the preferred substrate of the species. On bark, the apothecia tend to be flatter and slighter broader than on moss (0.15-0.2 vs. 0.1-0.15 mm), something pointed out by Coppins (1983). The description given by Poelt and Döbbeler (1979, sub *Bryostigma leucodontis*) agrees well with the QCI material except that I could not find halonate spores even in ink preparations. The descriptions in Coppins (1983, 1989) are even closer with regard to spore size and olive color reaction of the ascoma walls. The exsiccate material referred to by Coppins (1983), Vězda *Lich. Sel. Exs. 1701*, is a good match for the QCI specimen but is on *Ulmus* bark rather than on a conifer (*Tsuga*).

In most keys (e.g., Clauzade & Roux 1986), *A. muscigena* would key out to *A. exilis* (Flörke) Anzi or *A. tenellula* Nyl. Both these species have larger spores and broader ascomata and, in fact, the distinctions between them are small. The extent of thallus production (virtually absent in *A. tenellula*) seems to be substrate induced. The hypothecial color, said to be colorless by Clauzade & Roux (1986) is a difficult character to evaluate. In this and other small *Arthonia* species, the ascomatal tissue that surrounds the asci is generally similar in color and reaction with KOH on both sides of the "hymenium." In this case, the tissue is brown, changing to olive in KOH. Whether this layer is interpreted as a thin brown "exciple" having a hyaline "hypothecium," or a brown "hypothecium" is obviously open for debate and is the basis for conflicting statements in the literature. In his descriptions, Coppins (1983) makes this point very clearly.

One difference perhaps worth noting between the QCI material and European specimens I have seen is that the photobiont in the former has many small "autospores" forming within cells. No other material of any of the *Arthonia* species studied has a photobiont like this.

Bacidia subincompta (Nyl.) Arnold

GRAHAM ISLAND: Mt. Raymond - Slatechuck ridge, east slope, 53°16'N, 132°13'W, old *Tsuga heterophylla* - *Thuja plicata* forest on steep slope, with boggy flat areas, over moss at base of *Tsuga*, elev. 760 m, 13 July 1988, *Brodo* 26653B. Verified by S. Ekman.

***Byssoloma marginatum* (Arnold) Sérusiaux in Coppins, James & D. Hawksw.** (Syn. *Bacidia marginata* (Arnold) Lettau)

GRAHAM ISLAND: Tlell, along west shore of Tlell River inlet, 53°36'N, 131°56'W, including *Picea sitchensis* stand along the beach, and the open sand dune area at the point, on branches of *Picea sitchensis* at edge of inlet, 17 June 1967, *Brodo* 9990B. Determined by S. Ekman.

In the course of his work on the corticolous species of *Bacidia* s. lato, Stefan Ekman identified my material as "*Bacidia" marginata*, mentioning that it is not a true *Bacidia*. Sérusiaux transferred the species to *Byssoloma* in Coppins et al. (1992) without comment, but later (Sérusiaux 1992) compared it with other British species of *Byssoloma*, mentioning its pyriform conidia. Presumably, it has "*Byssoloma*-type" asci as well, mentioned by him as a generic character. *B. marginatum* differs from most other species of

Byssoloma in having a smooth rather than tomentose (byssaceous) true exciple.

Ekman (in litt.) collected *B. marginatum* in six localities from northern California to southern British Columbia growing on *Alnus rubra* and *Picea sitchensis*, making the Queen Charlotte specimen the northernmost locality.

Dactylospora parasitica (Flörke) Zopf

GRAHAM ISLAND: Jalun Lake, at the headwaters of the Jalun River, elev. 110 m, 53°58'N, 132°51'W, swampy *Thuja plicata* forest and open *Pinus contorta* bog, on *Graphis insidiosa* on *Malus* at edge of lake, 30 July 1967, *Brodo* 12912B, verified by R. Santesson; KUNGHIT ISLAND: At the foot of Balcom Inlet, 52°06'N, 131°01'W, *Picea* forest, on *Graphis insidiosa* on *Alnus rubra* along rocky shore of a small, well-lighted stream, 24 July 1967, *Brodo* 12414B; MORESBY ISLAND: Two miles SE of Sandspit, 53°14'N, 131°47'W, on small side road behind beach with windswept spruces and very old alders, on *Ochrolechia* on *Pyrus fusca*, 26 June 1971, *Brodo* 17112B, verified by R. Santesson.

Lichenicolous fungi are very poorly known in North America, and it is not surprising to note numerous new records from this group. *D. parasitica* differs from *D. parellaria* (see below) in having predominantly 3-septate spores, whereas in the latter, they are very variable, often with 1-septate spores predominating (Alstrup and Hawksworth 1990). The ascomatal tissues are mostly dark brown or red-brown in *D. parasitica* rather than greyish or yellowish brown (Triebel 1989, Alstrup and Hawksworth 1990), but to judge from Queen Charlotte specimens verified by Hawksworth (*Brodo* 11467A, see below) and Santesson (*Brodo* 12912B, 17112B) , the character is somewhat unreliable.

The occurrence of *D. parasitica* on a species of *Graphis* is very unusual. It normally grows on species of *Ochrolechia* or *Pertusaria*, members of an entirely different order.

***Dactylospora parellaria* (Nyl.) Arnold**

LONG INLET: Off Skidegate Inlet, small island off east shore of inlet west of Josette Point, 53°12'N, 132°16'W, *Thuja-Picea* stand and rocky shore, on *Ochrolechia laevigata* on dead shrub, 13 July 1967, *Brodo* 11467A.

This record is based on a tentative determination by Hawksworth in 1982, but seems to be correct. There is an additional specimen in UPS collected by John Macoun from Vancouver Island growing on *Ochrolechia oregonensis* (Santesson, in litt.). The spores of the QCI specimen are 1-3 septate and very variable in shape. The ascomatal tissues are reddish brown.

***Dictyonema moorei* (Nyl.) Henssen**

GRAHAM ISLAND: Eden Lake, middle of east shore, 53°51'N, 132°44'W, along rocky shore and in open sloping *Pinus contorta - Chamaecyparis nootkatensis* fen, with *Polychidium contortum*, 30 July 1967, *Brodo* 12968B. Determined by A. Henssen.

Henssen (1963) cites specimens of this tiny lichen from Japan and Chile, and illustrates it (Taf. 30c-e). It strongly resembles a species of *Polychidium*, but has ± flattened branches 20-50 µm wide and up to 0.2 mm long forming small, olive-brown (94[2]) to light green (143) polsters or cushions up to 3 mm across, with radiate branches. The photobiont *Scytonema* with cells 8.0-9.5 µm in diameter, with the filaments forming the core of the branch, surrounded by a hyaline fungal envelope consisting of angular but almost isodiametric cells ca. 7.0-8.0 µm in diameter. Rhizinae are abundant, non-septate and threadlike.

Endococcus perpusillus Nyl. (Syn. *Tichothecium perpusillum* (Nyl.) Arnold; *Discothecium calcaricola* (Mudd) Vouaux)

LINA ISLAND: South of Dyer Point, Skidegate Inlet, 53°13'N, 132°08'W, on shoreline rocks and trees and in *Thuja plicata - Tsuga heterophylla* forest on high ground in back of shore, on *Aspicilia* cfr. *caesiocinerea* on sandstone outcrop, at edge of beach, 12 July 1967, *Brodo* 11344. GRAHAM ISLAND: Ian Lake, east end on south shore, 53°47'N, 132°03'W, point of land, with rock outcrops and *Thuja-Tsuga* forest behind lake shore, on *Rhizocarpon lavatum* on rocks on beach, 15 July 1971, *Brodo* 18423B, verified by R. Santesson. MORESBY ISLAND: San Cristoval Range, 3.1 km east of end of Sunday Inlet, subalpine ridges, 52°41'N, 131°50'W, on *Rhizocarpon geographicum* on ridgetop outcrop, *Brodo* 26833, verified by R. Santesson.

This species differs from the similar *E. rugulosus* Nyl. (also on the Queen Charlotte Islands) in having somewhat longer and relatively narrower ascospores (Triebel 1989). In North America, it is known from the Appalachians (Triebel 1989).

***Fuscidea intercincta* (Nyl.) Poelt in Poelt & Buschardt**

MORESBY ISLAND: Takakia Lake, 52°56'N, 132°03'W, elev. 590 m, on vertical face of shoreline rock on east side of lake, 4 July 1967, *Brodo* 10920. Determined by V. Wirth.

This species, known from Scandinavia and Portugal, was discussed by

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[2] Numbers following color descriptions refer to standard colors illustrated in Kelly (1965).

Oberhollenzer & Wirth (1985), and will receive a detailed treatment in a forthcoming paper on the Lecideaceous crusts of the Charlottes.

Graphis insidiosa (C. Knight & Mitt.) Hook.

GRAHAM ISLAND: Jalun Lake, at the headwaters of the Jalun River, elev. 110 m, 53°58'N, 132°51'W, swampy, *Thuja plicata* forest and open *Pinus contorta* bog, on *Thuja*, 30 July 1967, *Brodo* 12892.

Graphis insidiosa belongs to a small group of mostly Asian, tropical or subtropical species having ascomata with non-carbonized (i.e., thallus-colored) excipular tissue, and with four-locular spores. The spore walls are thick and the locules are often separated from one another. It was described from New Zealand and is also known from the Azores (Arvidsson 1990), southeastern U.S. and the West Indies (Wirth & Hale 1978). The Charlotte material has IKI+ light violet ascospores, differing in this respect from description in Wirth & Hale (1978). The closely related *G. triticea* Nyl. is also supposed to have IKI- spores, but specimens from New Zealand (e.g., *Tibell* 13301, 13500, UPS!), agreeing in all other respects with the description, have spores that are IKI+ light violet. *Graphis triticea*, also unreported for northern North America, differs from *G. insidiosa* mainly in containing stictic acid (Wirth & Hale 1978). Galloway (1985) says that *G. insidiosa* has a black prothallus, which is lacking in our material. I believe that the limits between *G. insidiosa* and *G. tritacea* need reexamination, and the possibility of chemotypes should be considered. For the moment, however, the Charlotte material can be included in a broad concept of *G. insidiosa.*

Gyalidea lecideopsis (Massal.) Lettau ex Vězda var. *lecideopsis*

MORESBY ISLAND: Off Cumshewa Inlet, near Moresby Camp at Gillatt Arm, 53°02'N, 132°02'W, limestone outcrops and *Picea-Thuja* stand near road, on limestone of roadside, 1 July 1967, *Brodo* 10753A.

This species was reported from the Bering region by Vězda (1968) and Greenland by Hansen, Poelt & Vězda (1987). The variety *kurdistanica* (Steiner) Vězda in Poelt was recently cited from Louisiana (Vězda & Poelt 1991). The Charlotte specimen is identical with Vězda's *Lich. Sel. Exs. 2407* from Austria, except that the thallus in that material is blackish rather than yellow-white. Vězda (1968) describes the thallus as "grauweiss oder gelbich-grau."

***Gyalidea roseola* (Arnold) Lettau**

GRAHAM ISLAND: West of Queen Charlotte City, along Tarundl Creek, 53°15'N, 132°13'W, a swampy depression near the creek, on HCl-rock at edge of stream, 15 July 1967, *Brodo* 11598.

I compared the above specimen with the type in Munich ("Thonschufer der kleinen Bettenstein. Tirol 8/71. 292 ad Nyl. Gyalecta roseola"). There are beautiful spore drawings on the type, very old but probably not Arnold's. Although the spores are noted as being "8-9 x 3.5-4," the number may refer to units other than µm. Due to the scarcity of the material, I did not resection it. Vězda (1968) gives 20-30 x 8-12 µm for spore size, and I recorded (12.5-)18.5-24.2 x (7.6-)8.3-9.1 µm. In other respects, the match with the type is a good one.

The species is mostly alpine on siliceous rock. Other North American *Gyalidea* species are either 3-septate (*G. hyalinescens* (Nyl.) Vězda, *G. dodgei* Vězda) or have much larger spores (*G. lecideopsis* (Mass.) Lett.).

Ionaspis lavata H. Magn.

MORESBY ISLAND: San Cristoval Range, SSE of Mount Laysen, 3.1 km E of end of Sunday Inlet, 52°41'N, 131°50'W, on submerged rocks in stream by subalpine lake at 730 m, 18 July 1988, *Brodo* 26814.

This American endemic, described from Mt. Rainier in Washington, is close to the common European *I. odora* (Ach.) Th. Fr., which also occurs on the Queen Charlotte Islands in the same alpine, aquatic community. The two species differ in thallus and apothecial disk color: *I. lavata*: thallus distinctly pink in the field and yellowish white (92) in the herbarium, with deep brown (56) disks; and *I. odora*: thallus light olive-grey (265-112), sometimes becoming ochraceous, with pink to pale brown disks.

Lecanora hypopta (Ach.) Vain. (Syn. *Lecidea hypopta* Ach.)

GRAHAM ISLAND: Along the Yakoun River, about 5 miles north of Yakoun Lake, 53°26'N, 132°16'W, well lighted *Alnus rubra* - *Picea sitchensis* stand on bank, on exposed log, 16 July 1967, *Brodo* 11661.

This is a member of the very poorly understood group of small, lignicolous *Lecanorae* lacking atranorin. It is found throughout Scandinavia (Santesson 1993). Its generic position is still unclear. Examining the type (H-ACH 345b) as well as several specimens in UPS (e.g., Nylander & Norrlin *Herb. Lich. Fenn.* 742, cited by Vainio [1934]; *Nannfeldt* 16006, det. R. Santesson), I could find no algae in the apothecial margins, and the ascus tip is more similar to that of a *Biatora* than a *Lecanora* (e.g., in having no masse axiale). The paraphyses, however, are largely unbranched except for the tips. The epihymenium is not at all granular or inspersed. The Charlotte material agreed with Swedish specimens in every respect.

Lecanora hypopta is superficially similar to the bark-dwelling *Lecidea erythrophaea* Flörke ex Sommerf., common on the Charlottes, but differs in the lighter apothecial margin (when a margin is detectable), and in the browner rather than orange-tinted hypothecial tissue. The presence of a slightly darker brown upper part of the hypothecium seems to be characteristic of *L. hypopta*, as well as the almost capitate, diffusely pigmented tips of the paraphyses.

Lecanora poliophaea **(Wahlenb.) Ach. s. lato**

U.S.A. Alaska. Juneau, Sunshine Cove, 40 km W of Auke Bay, 58˚37'N, 134˚56'W, shoreline rocks with *Verrucaria maura*, *Brodo* 26020; Juneau, Shrine of Ste-Therese, ca. 15 km W of Auke Bay, 58˚28'N, 134˚47"W, rocky headline east of shrine, upper hygrohaline, *Brodo* 26141, 26146.

Canada. British Columbia, Queen Charlotte Islands. KUNGHIT ISLAND: Cape St. James, 51°56'N, 131°01'W, exposed grassy and rocky ridges, on protected side of HCl- rock on beach, aerohaline, 3 July 1971, *Brodo* 17635; BALCH ISLAND: Skidegate Inlet, north end of island at the entrance of Maude Channel, 53°14'N, 132°05'W, rocky shoreline and *Picea sitchensis - Thuja plicata* stand, on exposed calcareous rock in aerohaline, 14 July 1967, *Brodo* 11560B; LINA ISLAND: Skidegate Inlet, on west side of island, south of Dyer Point, 53°13'N, 132°08'W, on shoreline rocks and trees and in *Thuja plicata - Tsuga heterophylla* forest on high ground in back of shore, on non-calcareous shoreline rock, 12 July 1967, *Brodo* 11325; ROBBERS ISLAND: Skidegate Inlet, just off the east end of Maude Island, 53°13'N, 132°02'W, on rocks at shore in upper hygrohaline, 10 July 1967, *Brodo* 11145; WATHUS ISLAND: In Masset Inlet, southern point of land, 53°40'N, 132°29'W, shoreline rocks and forest, mostly *Picea sitchensis, Thuja plicata*, and *Pyrus fusca*, on HCl+ rock, 14 July 1971, *Brodo* 18300; on shoreline rocks upper hygrohaline, *Brodo* 18331B.

The Queen Charlotte and Alaskan material of this maritime species differs in certain respects from the European and Asian populations, but it appears to be at least conspecific. Noble (1982) referred to it as "*Lecanora* sp. #1." The problem is a complex one and will be discussed fully in a forthcoming paper on the Lecanoraceous crusts of the Queen Charlotte Islands (Brodo, in prep).

Lecanora tenera **(Nyl.) Cromb.** (Syn. *Lecidea tenera* Nyl. ; *Lecania tenera* (Nyl.) Clauzade & Roux in Roux, Bull. Soc. Bot. Centre-Ouest, Nouv. sér. 13: 210-228. 1982; syn. nov. *Lecidea expallescens* Nyl., Flora 67: 214. 1884. ≡ *Lecidea expallidescens* Nyl., Bull. Soc. linn. Norm., sér. 4, 1: 227. 1887 [nom. superf.]; non *Lecidea expallescens* (Th. Fr.) Nyl., Bull. Soc. linn. Norm., sér. 4, 1: 210. 1887 [≡ *Rhizocarpon expallescens* Th. Fr., Lich. Scand. 620. 1871.])

LANGARA ISLAND: Off the NW corner of Graham Island, Henslung Harbour (Dadens), 54°12'N, 133°00'W, along the wharf and beach on conglomerate rocks, 28 June 1967, *Brodo* 10601C.

As pointed out by Hawksworth and Dalby (1992), this species sits uneasily in *Lecanora*, with many characters pointing to *Lecania* (e.g., chemistry and conidia) where it was placed by Clauzade & Roux (1986, 1989; see Roux [1982] where the valid combination was made). In a recent discussion of the species, Arup and Eckman (1992) regarded it as closer to *Lecania*, but distinguished from that genus by some important characters. Pending a more comprehensive treatment of the group, I have chosen to follow Hawksworth and Dalby (1992) and the Swedish treatments (Arup and Eckman 1992; Santesson 1993).

An isotype specimen in UPS contains atranorin, stictic and constictic acid and agrees well with the Charlotte material, which grows in the same habitat as the western European specimens (moist cliff faces, especially close to the sea).

An examination of the holotype of *Lecidea expallescens* Nyl. (H-NYL 18879) (≡*Catillaria expallescens* (Nyl.) Zahlbr.) revealed it to be identical to *Lecanora tenera* morphologically and chemically (containing atranorin, stictic and constictic acids, but with a trace of zeorin). John Thomson had annotated it as "*Lecania.*"

"Lecidea" conferenda Nyl.

BALCH ISLAND (North): Skidegate Inlet, at the entrance of Maude Channel 53°14'N, 132°05'W, rocky shoreline and *Picea sitchensis* - *Thuja plicata* stand, on protected rock wall in aerohaline, 14 July 1967, *Brodo* 11528; HIPPA ISLAND: Off west coast of Graham Island, 53°32'N, 132°58'W, cove on west side, rocks along beach and wet spruce forest, on (HCl-) rock, 24 June 1967, *Brodo* 10375; LANGARA ISLAND: Off the NW corner of Graham Island, west of McPherson Point, 54°15'N, 132°59'W, bluffs and shoreline volcanic rocks, on rocks in lower aerohaline, 28 June 1967, *Brodo* 10650; MORESBY ISLAND: Jedway, 52°19'N, 131°12'W, rocky shore and *Picea-Tsuga* forest along Skincuttle Inlet, east of the settlement, on shoreline rocks, 25 July 1967, *Brodo* 12462; SKIDEGATE INLET: Long Inlet off Skidegate Inlet, small island off east shore of inlet west of Josette Point, 53°12'N, 132°16'W, *Thuja-Picea* stand and rocky shore, on rocks above shore, 13 July 1967, *Brodo* 11438. Several specimens verified or determined by H. Hertel.

The ascus type of this species is *Bacidia*-like rather than *Lecidea*-like, and a reevaluation of its generic status will soon appear (Hertel & Rambold, in prep). It is known from the southern Rocky Mountains, Greenland and many parts of Europe.

Lecidea crassilabra **Müll. Arg.**

MORESBY ISLAND: Takakia Lake, 52°56'N, 132°04'W, bluffs, outcrops and forests along the north side of the lake, elev 590-640 m, on vertical face of cliff, 6 July 1967, *Brodo* 11015A. Determined by H. Hertel.

This record is based on a single Charlotte specimen determined by Hannes Hertel. The species was previously known only from Australia (Rambold 1989) and New Zealand (Hertel, unpubl.). The epihymenium is a bit greener in the Australian populations, but the character is variable, as is thallus color (normally greyer, but rusty "oxydated" thalli known: Rambold [1989]). It is in the *L. lapicida* group.

"Lecidea" delincta Nyl.

GRAHAM ISLAND: Port Chanal, along the stream to Mercer Lake, 53°34'N, 132°53'W, on rock at edge of stream, 25 June 1967, *Brodo* 10403; Masset Inlet, on rock at stream edge in *Thuja-Alnus* forest, 53°38'N, 132°35'W, *Brodo 12970, 12975*; Juskatla, along Mainin River, 53°36'N, 132°17'W, fairly well lighted, tall *Thuja-Tsuga* forest alongside river, *Brodo* 9978; KUNGHIT ISLAND: Balcom Inlet, 52°06'N, 131°01'W, *Picea* forest, on rocks at edge of a small, well-lighted stream, 24 July 1967, *Brodo* 12416; MORESBY ISLAND: Skidegate Lake, 53°06'N, 131°57'W, on bridge (hard lignum), *Brodo* 17249; Copper Creek, on stream-side pebble, 53°10'N, 131°48'W, *Brodo* 26661.

The *Porpidia*-type ascus tips and occasionally halonate spores clearly indicate that the species is incorrectly classified within *Lecidea. Clauzadea* is a possible genus (and Rambold annotated a specimen as such), but the paraphyses in that genus are much branched, and the species are generally associated with highly calciferous rocks. *Mycobilimbia* has somewhat similar asci, but has non-halonate spores and a biatorine apothecial margin. A reclassification is best done by Hertel, Rambold or their colleagues, who have this and other Lecideaceous crusts under study.

The Charlotte material was found both on rock and hard lignum, always associated with fresh water. Vainio (1934) observed that *Lecidea delincta* could be lacustrine, but did not mention lignum as a possible substrate.

"Lecidea" erythrophaea Flörke ex Sommerf.

MORESBY ISLAND: 2 mi. SE of Sandspit, 53°14'N, 131°47'W, on small side road behind beach with windswept spruces and very old alders, on *Ochrolechia* on *Pyrus fusca*, 26 June 1971, *Brodo* 17155. Verified by

C. Printzen.

This species is being studied by C. Printzen in Munich. The Queen Charlotte population has slightly smaller spores than is usual, but otherwise agrees well with Scandinavian material. It somewhat resembles *L. atroviridis* (Arn.) Th. Fr. but has no green tissues, is entirely HNO_3 negative, and has no bluish "haze" on the apothecia, which is commonly seen in *L. atroviridis*. *Lecidea erythrophaea* has been reported from California by Tucker and Jordan (1978).

"Lecidea" limosa Ach.

MORESBY ISLAND: Head of Bigsby Inlet, 52°38'N, 131°46'W, along cascade, and in forest along south side of first lake west of inlet, *Tsuga - Thuja* forest, on mossy rock beside stream, 6 July 1971, *Brodo* 17848. This is a widely distributed arctic-alpine species.

***Lecidea swartzioidea* Nyl.**

MORESBY ISLAND: Takakia Lake, 52°56'N 132°03W, on rock at summit of high ridge at south end of lake, elev. 820 m, 5 July 1967, *Brodo* 10993. Verified by H. Hertel.

Santesson (1993) lists this as a synonym of *Lecidea lapicida* (Ach.) Ach. (norstictic strain, "var. *pantherina* Ach."), and Schwab (1986) also expresses doubts about its distinctiveness. Hertel (pers. comm.), however, regards the species as worth recognizing, although he says that there are intermediates.

Lecidella effugiens (Nilson) Knoph & Hertel in Knoph
(Syn. *Lecidea albidocinerella* (Vain. in Räsänen) Poelt & Vězda)

LANGARA ISLAND: Off the NW corner of Graham Island, Henslung Harbour (Dadens), 54°12'N, 133°00'W, along the wharf and beach on conglomerate rocks, 28 June 1967, *Brodo* 10622. (Other specimens seen from SE Alaska: Juneau area, *Brodo* 26024B; Sitka area, *Brodo* 26070.)

This European species, like others in the genus *Lecidella*, is under study by Johannes Knopf in Berlin. It was noted from the Great Slave Lake area (N.W.T.) by Thomson et. al (1969), and from Cape Breton Island (Nova Scotia) by Lamb (1954) under the name *Lecidea albidocinerella*.

Lithographa tesserata (DC.) Nyl.

GRAHAM ISLAND: Mercer Lake, ridges NE of lake, 53°34'N, 132°52'W, elev. 200 m, terraced fens, with *Pinus contorta* and *Tsuga mertensiana*, on stone in open fen, 21 July 1988, *Brodo* 26953.

This rare species, now placed in the Rimulariaceae by Hertel and

Rambold (1990), was first reported for North America from Mt. Albert in the Gaspé Peninsula of Québec by Sirois et al. (1988), and then from the Bering Strait region of Alaska by Flock (1989). In Europe, it has a broad arctic-alpine distribution (Hertel and Rambold (1990). Other localities are mentioned by Flock (1989). On the Charlottes, the lichen was growing on exposed stones on wind-swept, terraced fen slopes, similar to the habitats of other areas of the world (Hertel and Rambold 1990).

Micarea incrassata Hedl.

MORESBY ISLAND: Tasu, "Mine Mountain" [or "Tasu Mountain"], 52°45'N, 132°03'W, forested slopes and subalpine summit, on peat on ridge at 775m, 9 July 1980, *Brodo* 23650.

Micarea lignaria (Ach.) Hedl. var. *lignaria*

MORESBY ISLAND: 53°01'N 132°06'W, stream cut and cascade at the foot of Moresby Mountain on the north side, over mosses on moist rock face, 28 July 1968, *Brodo* 13966.

***Micarea subviolescens* (H. Magn.) Coppins**

MORESBY ISLAND: Mount Moresby, 53°00'N, 132°05'W, on face of outcrop on ridge at S end of subalpine meadow, 780 m, 15 July 1988, *Brodo* 26682; Takakia Lake, eastern alpine slopes above lake, elev. 730-790 m, 52°56'N, 132°02'W, alpine ridges, on stone in almost dry bed of alpine pool, 17 July 1988, *Brodo* 26799B. Verified by B. Coppins.

This is the first record of the species outside of Europe. Coppins (1983) cites only Hordaland and Troms in Norway, and gives a full description. It is an unusual species in having a cephalodioid association with more or less loose filaments of *Stigonema.*

Micarea turfosa (A. Massal.) Du Rietz

GRAHAM ISLAND: 3.2 miles S of Tow Hill, 54°02'N, 131°47'W, around small bog lake just west of trail from Tow Hill, and along trail, on soil of trail, 13 July 1971, *Brodo* 18212.

Although considered to be an arctic-alpine species (Coppins 1983), the Queen Charlotte specimen was at sea level.

***Micarea vulpinaris* (Nyl.) Muhr** (Syn. *M. muhrii* Coppins)

MORESBY ISLAND: San Cristoval Range, SSE of Mount Laysen, 3.1 km E of end of Sunday Inlet, 52°41'N, 131°50'W, subalpine lake, at edge, elev. 730 m, on submerged rocks in stream by lake 730 m, 18 July 1988, *Brodo* 26810D; Mount Moresby, cirque lake at SW side of mountain, on S shore of lake, elev. 640 m, 53°01'N, 132°05'W, *Tsuga mertensiana* forest and lakeshore, 16 July 1988, *Brodo* 26728[A?]. Verified by B. Coppins.

This extraordinary find broadens the distribution of this rare lichen from central Sweden (Värmland), where it originally was found growing on periodically inundated logs, to a saxicolous, alpine community in western North America. I had the pleasure of being taken to the type locality and shown the species by Lars-Eric Muhr, in whose honor the lichen was first named. The Queen Charlotte material, all saxicolous, differs in some respects from the lignicolous Swedish specimens, undoubtedly due to the difference in substrate. The species, however, does occur on stone in Sweden as well (Santesson, in litt..) A comparison is made in Table 1.

Table 1. Comparison of Queen Charlotte specimens and lignicolous Swedish specimens of *Micarea vulpinaris*.

	QCI Material	Swedish material
Thallus	continuous to membranous	± areolate to verruculose to rimose in places
Apothecial disk color	black to charcoal	charcoal to grey-brown (rarely black)
Apothecial margin	rarely seen	commonly seen (on almost all apothecia)
Epihymenium and hymenium	deep green	pale green to olive
Hypothecium	two layers	uniformly brown
Spores	10-12 x 5-6 μm	9-12 x 4-5 μm

The variation noted in Table 1 is not to be regarded as supporting the recognition of a separate taxon, but should be noted for future work when more material is discovered. Variation in lichens on different substrates, especially when inundated, is well known.

Miriquidica atrofulva (Sommerf.) A.J. Schwab & Rambold in Rambold & A.J. Schwab

MORESBY ISLAND: Takakia Lake, 52°56'N, 132°04'W, bluffs, outcrops and forests along the north side of the lake, elev. 590-640m, on vertical face of cliff, 6 July 1967, *Brodo* 11015B.

This species was reported from the north slope of Alaska by Schwab (1986), who described and discussed the species in detail. Rambold and Schwab (1990) transferred the species to the genus *Miriquidica*, and presented a world map of its distribution. The Queen Charlotte specimen, which was sterile, was growing with *Acarospora sinopica* (Wahlenb. in Ach.) Körber as is commonly the case throughout its range (Schwab 1986).

Pertusaria glomerata (Ach.) Schaer.

GRAHAM ISLAND: Just east of Skonun Point ca. 4 miles east of Masset on the Masset-Tow Hill Road, 54°02'N, 132°03'W, dune and beach area between road and water, *Picea sitchensis* stand, on *Picea sitchensis*, 12 July 1971, *Brodo* 18186.

Pertusaria glomerata is another arctic species (like *Micarea turfosa*) found close to sea level in the Tow Hill area on the north shore of the Queen Charlotte archipelago. Dibben (1980) notes scattered localities from Alaska to Baffin Island in North America.

***Pertusaria hakkodensis* Yasuda ex Räsänen**

GRAHAM ISLAND: West of Queen Charlotte City, along Tarundl Creek, 53°15'N, 132°13'W, a swampy depression near the creek, on *Alnus rubra* at edge of stream, 15 July 1967, *Brodo* 11619.

Although tentatively reported for North America in Noble et. al. (1987) and Egan (1987), the record is confirmed and documented here. The well-developed Queen Charlotte specimen was compared with the type in H (Japan, Prov. Mutso, Mt. Hakkoda) and was identical. It was previously known only from Japan (Oshio 1968), an example of the Asian element on the Charlottes. The species is very much like *P. sommerfeltii* (Sommerf.) Fr. (both contain 2,7 dichlorlichexanthone) but has larger spores (35-55 µm vs. 16-48 µm long) and lacks stictic acid. Oshio (1968) states that the ascospores are "35-40 x 17-25 µ", but notes on the type agree with my own measurements as given above. *Pertusaria sommerfeltii* has a tendency for duller, whiter, multi-ostiolate verrucae, and the spores are usually uniseriate; *P. hakkodensis* is more ampliariate with a single ostiole per verruca, yellower, and the spores are biseriate.

Phaeospora rimosicola (Leight. ex Mudd) Hepp (Syn. *Sphaerulina endococcoidea* (Nyl.) Sacc. & D. Sacc.; *Pyrenulella endococcoidea* (Nyl.) Fink; *Pyrenula endococcoidea* (Nyl.) Willey)

GRAHAM ISLAND: Seal Inlet in Rennell's Sound, 53°31'N, 132°44'W, shoreline around a small cove on the west shore of the inlet, on shaded rock above littoral zone, 23 June 1967, *Brodo* 10274; LONG INLET: Off Skidegate Inlet, small island off east shore of inlet west of Josette Point, 53°12'N, 132°16'W, *Thuja-Picea* stand and rocky shore, on rock above shore, 13 July 1967, *Brodo* 11437.

Both Charlotte specimens were growing on *Rhizocarpon hochstetteri* s. lato on maritime rocks. Clauzade et al. (1989) record it (sub *Sphaerulina endococcoidea*) as growing on *R.. concentricum*. It was first recorded for North America by Willey (1892) from the New Bedford, Massachusetts, area growing on "*Buellia petraea*" (= *Rhizocarpon concentricum* in most cases). It is apparently new for Canada.

Pilophorus dovrensis (Nyl.) Timdal, Hertel & Rambold in Hertel & Rambold (Syn. *Lecidea pallida* Th. Fr., *Pilophorus pallidus* (Th.Fr.) Timdal)

GRAHAM ISLAND: 1.5 miles south of Juskatla along the Mainin River at bridge, 53°36'N, 132°17'W, deep rocky gorge and shore, fairly well lighted, with tall *Thuja-Tsuga* forest alongside the river; on pebbles in old road bed, 17 June 1967, *Brodo* 9959. Determined by H. Hertel.

The genus *Pilophorus* is characterized by its solid pseudopodetia upon which the spherical or elongate apothecia develop. On this species, however, the apothecia develop directly on the cephalodiate, primary, crustaceous thallus, looking very much like a lecideoid crust (see synonymy above). Although many species of *Pilophorus* can have sessile apothecia on occasion (Jahns 1981), this is the only one to do so consistently. The *Porpidia*-like ascus tip and narrowly ellipsoid, non-halonate spores, together with apothecial anatomy and cephalodial production establish its identity with *Pilophorus*, something first noted by Timdal (1988). Hertel and Rambold (1988) fully discuss the anatomy, biology and classification of the species, and map its world distribution. The thallus and cephalodia of the Queen Charlotte specimen, although different from those described in Hertel and Rambold (1988) are within the range of variation of the species. The anatomy of the apothecia is identical. As in "*P. pallidus*" (Timdal 1988), the thallus contained isousnic acid. Its granular cephalodia had both *Gloeocapsa* and *Nostoc* together, whereas Timdal (1988) noted that they were in different types of cephalodia in his material.

Pilophorus dovrensis is taxonomically very close to *P. acicularis*, which happens to be growing on the same pebbles. Known from arctic Alaska and

Greenland (Hertel & Rambold 1988) as well as the Yukon Territory (Thomson, in press), *P. dovrensis* is still another example of an arctic species found close to sea level in Graham Island (see *Micarea turfosa* and *Pertusaria glomerata* above). It is unlike the other records, however, in being in a relatively protected locality.

Pilophorus robustus Th. Fr.

FREDERICK ISLAND: The northeast corner near Dalton Point, 53°56'N, 133°10W, rocks and trees along shore and a small bluff, on exposed aerohaline rocks, 27 June 1967, *Brodo* 10559; GRAHAM ISLAND: Just east of Skonun Point ca. 4 miles east of Masset on the Masset-Tow Hill Road, 54°02'N, 132°03'W, dune and beach area between road and water, *Picea sitchensis* stand, on rotting log on open hind beach, 12 July 1971, *Brodo* 18179.

This circumpolar, mainly arctic species was known from a number of localities in Alaska, the Aleutians and Siberia (Jahns 1981). The specimen on rotting wood (18179), which is a very unusual substrate, is somewhat aberrant in morphology, with twisted, often blackened pseudopodetia. The pseudopodetia are, however, robust and branched. The occurrence of arctic or alpine species on exposed, maritime rocks (e.g., 10559) is not out of the ordinary on the Charlottes.

Polyblastia cruenta (Körb.) P. James & Swinscow

MORESBY ISLAND: Head of Bigsby Inlet, 52°38'N, 131°46'W, along cascade, and in forest along south side of first lake west of inlet, *Tsuga - Thuja* forest, On rocks at lakeshore, 6 July 1971, *Brodo* 17840; Mt. Moresby, cirque lake at SW side of mountain, on S shore of lake, elev. 640 m, 53°01'N, 132°05'W, *Tsuga mertensiana* forest and lakeshore, on submerged HCl- rocks at lakeshore, 640 m, 16 July 1988, *Brodo* 26731B; Takakia Lake, elev. 590 m, 52°56'N 132°03'W, along shore and in fens just back from shore on east side of lake, on submerged rocks, 4 July 1967, *Brodo* 10883.

The Queen Charlotte specimens agree well with material from eastern Europe and Scandinavia in UPS, including the slides of isotypes of *P. henscheliana* (Körb.) Lönnr. and *P. cruenta* (see synonymy in Santesson 1993). A good description is found in Swinscow (1971). Thomson (in press) reports it from Victoria Island and northern Ellesmere Island in the Northwest Territories of Canada.

(*Polychidium contortum* Henssen)

GRAHAM ISLAND: Near head of Dinan Bay, 53°39'N, 132°41'W, *Thuja-Tsuga-Picea* forest on shore of boulder beach, on twigs of *Picea* at edge of beach, 14 July 1971, *Brodo* 18384; GRAHAM ISLAND: Yakoun Lake, SE shore, just N of river entrance, 53°18'N, 132°16'W, elev. 106 m, boggy, grassy edge of lake with young *Pinus, Thuja, & Picea*, on *Pinus contorta* by lakeshore, 20 July 1988, *Brodo* 26855. Verified by A. Henssen.

This species was already reported as new to North America in Brodo & Tønsberg (1994), and is included here to document the record with specimen citations and some discussion. *Polychidium contortum* was described and known only from New Zealand, is very close to *P. dendriscum* (Nyl.) Henssen, a more widely distributed oceanic lichen (Henssen 1963). The jigsaw puzzle-like cortical cells seen especially near the branch tips seems to be diagnostic, as well as the spiralled and twisted filaments of *Scytonema.* As in New Zealand (see Galloway 1985), it was found in moist areas in fairly open, well lighted conditions, although mostly on the undersurface of the twigs and branches.

Porpidia flavocaerulescens (Hornem.) Hertel & A.J. Schwab in Hertel (Syn. *P. flavicunda* Gowan)

MORESBY ISLAND: "Laing Point", Mount Moresby. cirque lake at SW side of mountain, on S shore of lake, elev. 640 m, 53°01'N, 132°05'W, *Tsuga mertensiana* forest and lakeshore, 16 July 1988, *Brodo* 26728A; Mt. Moresby, cirque lake at SW side of mountain, on S shore of lake, elev. 640 m, 53°01'N, 132°05'W, *Tsuga mertensiana* forest and lakeshore, 16 July 1988, *Brodo* 26737; Takakia Lake, 52°56'N 132°03W, slope and summit at high ridge at south end of lake, on rock at summit, elev. 869 m, 5 July 1967, *Brodo* 10969; Tasu, 52°45'N, 132°03'W, on mined mountain behind Tasu camp, on summit rocks, elev. 915 m, 28 July 1967, *Brodo* 12829.

Gowan (1989) maps the distribution of this species (sub *P. flavicunda*) showing it is a circumpolar low arctic species known from as close as Southeast Alaska. Gowan and Ahti (1993) recently discussed its complex taxonomy. Santesson (1993) accepts the unambiguous "*P. flavicunda*" as the correct name to avoid confusion, and is proposing *Lecidea flavocaerulescens* Hornem. as a *nomen rejiciendum* (Santesson, in prep.). The Queen Charlotte material belongs to Chemotype I, with confluentic acid as the main constituent (Gowan 1989).

Porpidia melinodes (Körb.) Gowan & Ahti (Syn. *P. flavocaerulescens* sensu Gowan 1989)

GRAHAM ISLAND: Seal Inlet in Rennell's Sound, 53°31'N, 132°44'W, bluffs and boggy area above, forest and shoreline around a small cove on the west shore of the inlet, 23 June 1967, *Brodo* 10273; MORESBY ISLAND: Mt. Moresby, cirque lake at SW side of mountain, on S shore of lake, elev. 640 m, 53°01'N, 132°05'W, *Tsuga mertensiana* forest and lakeshore, 16 July 1988, *Brodo* 26728A.

This is the sorediate counterpart of *P. flavocaerulescens* (see above). It has been recorded from Newfoundland, and scattered localities in the Northwest Territories and coastal Alaska. Number *10273* belongs to the stictic acid-containing chemotype (IV) (Gowan 1989).

Porpidia ochrolemma (Vain.) Brodo & R. Sant., comb. nov. (Syn. *Pertusaria ochrolemma* Vain., Meddel. Soc. Fauna Fl. Fennica 6:180. 1881. *Hymenelia ochrolemma* (Vain.) Gowan & Ahti. *Porpidia pseudomelinodes* A.J. Schwab)

MORESBY ISLAND: Head of Bigsby Inlet, 52°38'N, 131°46'W, along cascade, and in forest along south side of first lake west of inlet, *Tsuga - Thuja* forest, on upper surface of rock at lake edge, 6 July 1971, *Brodo* 17841.

Gowan and Ahti (1993) transferred this sterile species into *Hymenelia*, but Professor Santesson and I prefer to leave it in *Porpidia* for the present since its chemistry (with stictic acid complex) is quite unlike anything else in the Hymeneliaceae s. str. (i.e., excluding *Aspicilia*). It is a rare arctic-alpine species in North America (Gowan 1989).

Porpidia speirea (Ach.) Kremp.

CHAATL ISLAND: Cove on west coast, on NE corner of island, facing ocean, 53°08'N, 132°35'W, headland rocks, elev. 0-9 m, headland rocks in lower aerohaline, 22 July 1988, *Brodo* 26969; GRAHAM ISLAND: Seal Inlet in Rennell's Sound, 53°29'N, 132°47'W, volcanic sea stacks (outcrops) and surrounding spruce-alder forest, lower aerohaline in protected cove, 23 June 1967, *Brodo* 10324; HIPPA ISLAND: Off west coast of Graham Island, 53°32'N, 132°58'W, cove on west side, rocks along beach, on (HCl-) rock in lower aerohaline, 24 June 1967, *Brodo* 10371B; LANGARA ISLAND: Off the NW corner of Graham Island, Henslung Harbour (Dadens), 54°12'N, 133°00'W, along the wharf and beach including the conglomerate rocks, 28 June 1967, *Brodo* 10601A; LONG INLET: off Skidegate Inlet, small island off east shore of inlet west of Josette Point, 53°12'N, 132°16'W, on rocks above shore, 13 July 1967, *Brodo* 11445; MORESBY ISLAND: North shore of Copper Bay, 53°11'N, 131°46'W, on rocks in lower aerohaline, 27 June 1971, *Brodo* 17265; TORRENS ISLAND: 1/2 mi. SE of Skidegate Mission, 53°15'N, 131°59'W, basaltic and breccia rock knoll and headland with *Thuja-Picea* forest, 28 June 1971, *Brodo* 17328.

Porpidia speirea, recorded from scattered arctic, alpine and boreal localities in North America by Gowan (1989), was surprisingly common on the Charlottes, always on maritime rocks in the aerohaline (salt spray) zone.

Psorotichia schaereri (A. Massal.) Arnold

GRAHAM ISLAND: Queen Charlotte City, 29 June 1957, *H. Persson* 49. [S]

The Persson specimen is perfectly typical when compared to European material. I never collected it on the Charlottes myself. Its taxonomy needs clarification (Henssen, pers. comm.), so its North American distribution is uncertain. It was recently reported from the Yukon Territory (Thomson & Ahti 1994).

Pyrenopsis tasmanica **Nyl.**

MORESBY ISLAND: Tasu, 52°45'N, 132°03'W, on mined mountain behind Tasu camp, in subalpine forest, meadow, and on summit rocks, on rocks on subalpine slope, 915 m, 28 July 1967, *Brodo* 12839. Determined by A. Henssen.

The Queen Charlotte specimen was compared with the lectotype in MB (see especially Henssen prep # 30666-867). Other than the thallus, which was somewhat flatter and more featureless, and apothecia that were slightly more marginate and "sessile," the specimen agreed in every respect. The thallus is red-brown, especially when wet, indefinite, granulose-areolate, with areoles (0.3-)0.7-1.0 mm across, almost peltate, and becoming almost lobate at the thallus edge, ± paraplectenchymatous throughout, containing *Gloeocapsa* in red-orange sheaths, cells 12.5-18 µm in diameter; apothecia sessile to sunken, 0.1-0.2 mm in diameter, disk opening very narrow, red-brown, margin thick, smooth, even; hymenium hyaline to yellowish, 50-85 µm high, epihymenium reddish brown where developed, not granular or inspersed, paraphyses ± simple, coherent in H_2O; tips of asci with outer layer dark blue in Lugol's (1.5%) following KOH treatment (K/I), sometimes with an even darker-reacting lining, lower layer light blue; ascospores 8.0-10.0 x 4.0-5.3, hyaline, sometimes appearing partially septate, 8:nae.

The species was previously known only from Tasmania and New Zealand.

Stigmidium *ephebes* (Henssen) D. Hawksw. (Syn. *Pharcidia ephebes* Henssen)

MORESBY ISLAND: Base of Moresby Mt. on the north side, 53°02'N, 132°06'W, rock outcrops and slopes near waterfall, on *Ephebe lanata*, on rock near stream, 1 July 1967, *Brodo* 10767. Determined by A. Henssen.

Henssen (1963) records the species from the United States and throughout Europe parasitizing *Ephebe lanata*, as well as from Japan, Brazil and Greenland on other species of *Ephebe.*

Strigula stigmatella (Ach.) R.C. Harris in D. Hawksw., P. James & Coppins

GRAHAM ISLAND: Along the Yakoun River, about 5 miles north of Yakoun Lake, 53°26'N, 132°16'W, well lighted *Alnus rubra - Picea sitchensis* stand on bank, on shaded root of *Alnus rubra* just above water level, 16 July 1967, *Brodo* 11662. Determined by R.C. Harris, 1970.

Harris (1977) included the species in the Michigan flora under the name *Arthopyrenia faginea* (Schaerer) Swinscow, and Brodo (1988b) recorded it from Ontario and Québec.

Tephromela aglaea (Sommerf.) Hertel & Rambold

MORESBY ISLAND: "Laing Point" Mountain SE of road into Peel Inlet ca. 1 mile east of Laing Point on the inlet, 52°59'N, 132°04'W, forested slope and subalpine bluffs near summit, elev. 640 m, on exposed rock, 2 July 1967, *Brodo* 10789; Base of Moresby Mt. on the north side, 53°02'N 132°06'W, rock outcrops and slopes near waterfall, elev. 90 m, exposed bluff, 1 July 1967, *Brodo* 10760; Ridge and fens SW of head of Skaat Harbour, 52°23'N, 131°28', plateau and ridge areas with mixed fen "flushes" and *Pinus contorta - Chamaecyparis nootkatensis* stands, on rock of open ridge 370 m, 5 July 1971, *Brodo* 17781; GRAHAM ISLAND: Carew Bay Mountain, 53°18'N, 132°37'W, on rock at summit, 22 June 1967, *Brodo* 10259.; VAN INLET: 1.5 miles from entrance on north side, on bluffs and bogs just east of a waterfall, 53°16'N, 132°37'W, elev. 130 m, On exposed rocky bluff, elev. 210 m, 21 June 1967, *Brodo* 10210.

This is mainly a circumpolar, arctic-alpine species (Hertel 1991) but is recorded from Southeast Alaska by Thomson (in press).

Verrucaria amphibia Clemente

MORESBY ISLAND: Northeast shore of Louscoone Inlet, 52°13'N, 131°15'W, along rocky beach and in *Picea-Tsuga* forest, in upper hygrohaline, 24 July 1967, *Brodo* 12306. Determined by R. Santesson.

This species is described and discussed by Taylor (1974), who reported it from Newfoundland as new to North America. The Queen Charlotte specimen is thin and not well developed, and was named as *V. amphibia* by Professor Santesson only with some hesitation.

Verrucaria applanata **Hepp ex Zschacke**

MORESBY ISLAND: Mount Moresby, cirque lake at SW side of mountain, on S shore of lake, elev. 640 m, 53°01'N, 132°05'W, *Tsuga mertensiana* forest and lakeshore, on submerged HCl- rocks at lakeshore, 640m, 16 July 1988, *Brodo* 26731A; San Cristoval Range, SSE of Mount Laysen, 3.1 km E of end of Sunday Inlet, 52°41'N, 131°50'W, subalpine lake, at edge, elev. 730 m, on subalpine ridges, 18 July 1988, *Brodo* 26823A.

In *V. applanata*, the spores are very long (33-42 x 12-14 µm), about the same as in *V. funckii* (Sprengel in Funck) Zahlbr., but the thallus is thinner and more membranous, and there is no basal black medullary layer. Wirth (1980), however, included the population lacking a black medulla within *V. funckii*. Both *V. applanata* and *V. funckii* from the Charlottes have larger spores than are reported in the literature, e.g., Zschacke in Rabenhorst (9:1:1, p. 215): 26-36 × 8-13 µm. The QCI specimen agrees well with Zwack-Holzhausen Lich. Exs. 212B (UPS) cited by Zschacke (loc. cit.) except for a darker thallus and the somewhat larger spores.

This and the other species of *Verrucaria* listed here will be keyed out and discussed in a forthcoming paper on the pyrenocarpous crusts of the Queen Charlottes.

Verrucaria degelii R. Sant.

LOUISE ISLAND: Vertical Point, 52°54'N, 131°37'W, on calcareous outcrop in lower aerohaline, 21 July 1967, *Brodo* 12048.

Taylor (1974) regarded this species to be little more than a habitat modification (sun form?) of *V. ceuthocarpa* Wahlenb. in Ach. Gowan and Brodo (1988), however, distinguished the two, and included both in the lichen flora of Fundy National Park in New Brunswick, Canada.

Verrucaria cfr. *elaeomelaena* (A. Massal.) Arnold non auct.

MORESBY ISLAND: Copper Creek, 3.5 km S of Copper Bay, at bridge, 53°10'N, 131°48'W, on streamside calcareous rocks, 14 July 1988, *Brodo* 26657.

The Charlotte material agrees well with specimens in UPS, except that the perithecia are somewhat more emergent. A full discussion will follow at a later date (Brodo, in prep.).

Verrucaria halizoa Leight. (Syn. *V. microspora* auct. non Nyl.)

MORESBY ISLAND: Head of Slim Inlet along east shore and in open *Pinus - Chamaecyparis* bog to the south, 52°16'N, 131°19'W, elev. ca.

15 m, on stone in freshwater spring, upper intertidal, 4 July 1971, *Brodo* 17745; GRAHAM ISLAND: Image Point, between Skidegate and Skidegate Mission, on maritime outcrop above high tide level, 5 June 1964, *Schofield* 2359, with Vaarama (UBC).

This species is a common lichen on intertidal rocks along the east coast (Taylor 1974; Gowan & Brodo 1988), but this appears to be is the first west coast record.

Verrucaria praetermissa (Trevis.) Anzi

GRAHAM ISLAND: Along the Yakoun River, about 5 miles north of Yakoun Lake, 53°26'N, 132°16'W, well lighted *Alnus rubra - Picea sitchensis* stand on bank, on partially submerged stone, 16 July 1967, *Brodo* 11656.

The perithecia on the QCI material are on the large side (see Swinscow 1968), but all other characters fit perfectly with published descriptions and European specimens in UPS. *V. aethiobola* Wahlenb. in Ach. is said to be similar, but has a darker and thinner thallus, and the perithecial involucrellum is distinct from the excipulum.

Verrucaria silicicola Fink

HUXLEY ISLAND: Off east coast of Moresby Island north of Burnaby Island, on north shore, 52°28'N, 131°21'W, calciferous and volcanic rock, mostly shale, forming rocky points and high wet rock walls, on vertical rock face, aerohaline, 1 July 1971, *Brodo* 17542; LANGARA ISLAND: Off the NW corner of Graham Island, Henslung Harbour (Dadens), 54°12'N, 133°00'W, along the wharf and beach including the conglomerate rocks, in aerohaline, 28 June 1967, *Brodo* 10637; MORESBY ISLAND: Jedway, 52°19'N, 131°12'W, rocky shore and *Picea-Tsuga* forest along Skincuttle Inlet, east of the settlement, on rocks (HCl-) above shore, 25 July 1967, *Brodo* 12476; North shore of Copper Bay, on rocky shore, 53°11'N, 131°46'W, on rocks in lower aerohaline, 27 June 1971, *Brodo* 17265; Kwuna Point, just east of Alliford Bay on Skidegate Inlet, 53°13'N, 131°59'W, on rocks at edge of beach, 11 July 1967, *Brodo* 11189; ROBBERS ISLAND: Skidegate Inlet, Robbers Island just off the east end of Maude Island, 53°13'N, 132°02'W, on HCl- rock wall at edge of beach, 10 July 1967, *Brodo* 11124.

The occurrence of this rare east coast species on the Queen Charlotte Islands is remarkable. It was described from Long Island, N.Y., and was known only from there (Brodo 1968; Taylor 1974). The combination of a thin, dark brown, membranous thallus and large spores (14-20 x [4.5-]6.5-10 µm) is very distinctive. The thallus forms a kind of fimbriate network resembling a prothallus, and consists of a dark brown, isodiametric, paraplectenchyme, with cells ca. 4.5-6.5 μm in diameter.

Xylographa trunciseda **(Th. Fr.) Minks in Redinger**

GRAHAM ISLAND: Head of Ian Lake, 53°43'N, 132°43'W, along lakeshore with *Thuja, Pyrus, Picea, Tsuga,* and *Alnus* behind boulder beach, on exposed rotting log, 15 July 1971, *Brodo* 18452; 6.6 miles SE of Port Clements, 53°38'N, 132°03'W, in open swamp alongside Gold Creek, dominant tree *Pinus contorta,* on *Pinus contorta,* 15 June 1967, *Brodo* 9794; 4 miles west of Tow Hill, 54°02'N, 131°55'W, in small, open, roadside swamp, with *Picea sitchensis - Thuja plicata* and *Tsuga heterophylla,* on rotting log, 13 July 1971, *Brodo* 18257; MORESBY ISLAND: Sandspit, along roadsides and bordering local farms, 53°15'N, 131°49'W, on exposed log, 19 June 1967, *Brodo* 10069.

The genus *Xylographa* is badly in need of revision. The chemistry will be important, with species often containing stictic and/or norstictic acid, or sometimes a distinctive UV++ blue-white unknown ("Xhn-1") running at A=2, B'=3, and C=2, in the standard TLC methodology (Culberson 1972; Culberson and Johnson 1982) as in *X. trunciseda.* The specimens from the Queen Charlottes as well as at least one from Sweden (Södermanland, 1881, *Blomberg*: [UPS]) contain Xhn-1, although two syntypes of *X. trunciseda* (Sweden, Dalsland, Laxarby, 1870, *Hulting*; Uppsala, Oct. 1870, *Th.M. Fries* [UPS]) did not. It is the only *Xylographa* on the Charlottes lacking stictic or norstictic acids.

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MYCOTAXON

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GANODERMA HILDEBRANDII, A FORGOTTEN SPECIES

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ABSTRACT

Ganoderma hildebrandii Henn., G. nigrolucidum (Lloyd) Reid and G. leucocreas Pat. & Har. are described and compared. These species are known only from Africa and are characterized by centrally stipitate, shiny black basidiocarps and strongly dextrinoid hyphae. G. nigrolucidum was found to be a synonym of G. hildebrandii while for the time being G. leucocreas is maintained as a distinct species. Both species may be intermediate between Ganoderma and Amauroderma.
Keywords: Ganoderma, dextrinoid skeletal hyphae.

INTRODUCTION

Ganoderma hildebrandii was described by P. Hennings in a paper written by Patouillard (1889:69). The type came from the Comoro Islands, a string of small islands between Madagascar and Mozambique. Later the species was illustrated by Bresadola (1932) who repeated Hennings description and added that it was close to Ganoderma laccato (Timm.) Pat. (= G. lucidum (Curt.:Fr.) Karst.). The species then went into oblivion and Furtado (1981:100) listed it under "Taxa of uncertain affinity, excluded or insufficiently known".

Furtado (op. cit.) stated that G. leucocreas Pat. & Har. could be a synonym of G. hildebrandii Henn. and cited a collection by Dybowski from Congo determined by Patouillard as G. leucocreas.

However, this is not the type which came from Loango in Congo and was collected in 1905 by an unknown collector.
The type of G. leucocreas was examined by one of us (Ryvarden 1983) and although a certain similarity exists, there are some differences which we think warrant keeping G. leucocreas as a separate species.

Steyaert, who studied the genus Ganoderma intensively during his last years, never published on G. hildebrandii, but he left notes on the species which kindly have been placed at our disposal by Dr. J. Rammeloo at the Botanical Garden in Bruxelles. G. hildebrandii was not mentioned by Corner (1983) in his survey of Ganoderma.
During our examination of undetermined Ganoderma specimens, a thin, slender specimen from Liberia attracted our attention by its black, shiny stipe and white pore surface. The specimen was examined and the name G. hildebrandii soon came into consideration because of a unique combination of characters. A comparison with notes by the late R. L. Steyaert, based on the type of G. hildebrandii indicated without doubt that the Liberia collection was a specimen of G. hildebrandii. In addition, Steyaert's notes suggested that he was considering a possible synonymy between G. hildebrandii, G.nigrolucidum and G. leucocreas. The types of the latter two species were examined by one of us (L.R.) in connection with studies on the types of Lloyd (Ryvarden 1990) and of Patouillard (Ryvarden 1983), respectively.

Since G. hildebrandii has conspicuous basidiocarps that are easy to recognize macroscopically, we decided that it would be appropriate to provide a modern description and to compare it with G. leucocreas and with G. nigrolucidum. The latter name was found to be a synonym of G. hildebrandii.

GANODERMA HILDEBRANDII Henn. Fig. 1.
Bull. Soc. Mycol. Fr. 5:69, 1889. - Polyporus nigrolucidus Lloyd in Lloyd Mycol. Writ. 6:925, 1920. - Ganoderma nigrolucidum (Lloyd) D. A. Reid. Bothalia 11:221-230, 1974.

Basidiocarp centrally stipitate; pileus circular, up to 2-9 cm wide and 5 mm thick at the centre, upper surface reddish to umber brown, becoming almost black and shiny, in young specimens smooth, dull, strongly concentrically sulcate, and in section with a thin dark cuticle; stipe up to 9 cm long, 3-12 mm in diam, black and shiny, inner parts soft and white without a hollow core; pore surface white to pale cream; pores minute, 7-8 per mm, becoming larger and 5-6 per mm in older specimens; tubes white to isabelline, up to 3 mm deep; context cottony, white or isabelline, up to 3 mm thick.

Hyphal system dimitic; generative hyphae with clamps, 2-5 μm wide; context and stipe core dominated by skeletal hyphae which are sinuous, thick-walled, 3-6 μm wide and strongly dextrinoid in Melzer's reagent; pileus cuticle consisting of apically widened hyphal ends from generative hyphae, individual apical cells yellow in KOH, 18-35 x 6-15 μm, arranged in a dense palisade, cuticle on stipe of the same type as on the pileus; basidia not seen; basidiospores ellipsoid to drop shaped, slightly truncate, pale yellow, wall thickness 0.5 μm, inner surface strongly ornamented, 7-8(8.5) x 4.5-5.5(6) μm inclusive of ornamentation. Reid (op. cit.) states that the spores in the type of G. nigrolucidum are 8-9.7 x 6.2-6.5 μm.

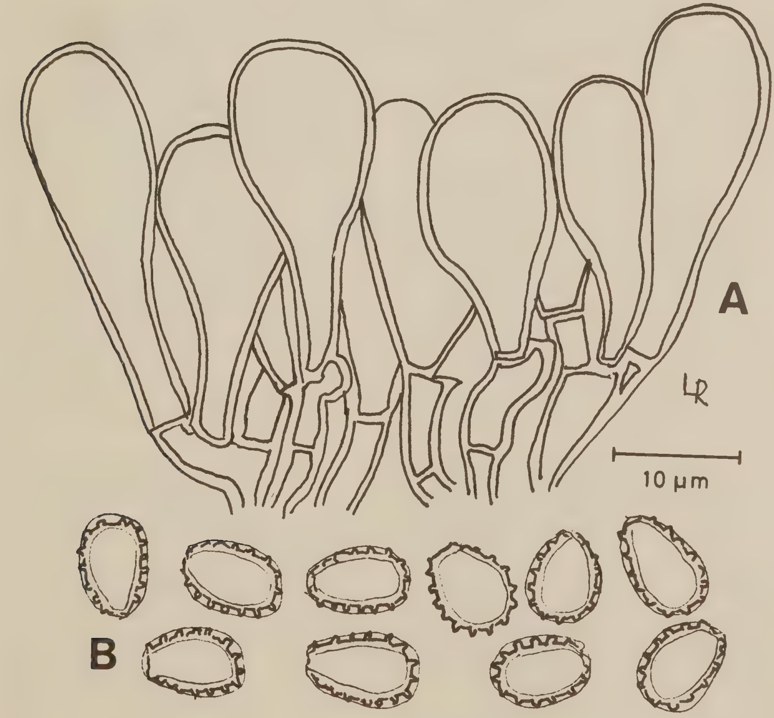

Fig. 1. G. hildebrandii, A) Apical cells from pileus, B) Basidiospores. (Coll. Liberia, Ganta, leg. W. Harley, O).

Apparently growing on the ground, probably from roots or buried wood. Known from the Comoro Islands (type locality of G. hildebrandii), and Liberia (Ganta, 8. June 1940, leg. W. Harley, O) and South Africa (type of G. nigrolucidum).

There is a colour illustration based on the type collection of G. hildebrandii in Bresadola 1932, table 1009. The type collection in Berlin was destroyed during the second world war and only a fragment remains in the Kew herbarium where it arrived via the herbarium of J. Bresadola. The above description is based on these three collections.

This is a striking species in many respects. Firstly the centrally stipitate basidiocarp has a dull concentric brown pileus that becomes shiny black like the surface of the stipe. The white pore surface, tubes and context are also unusual in the genus where brown colours dominate. Microscopically the strongly dextrinoid skeletal hyphae

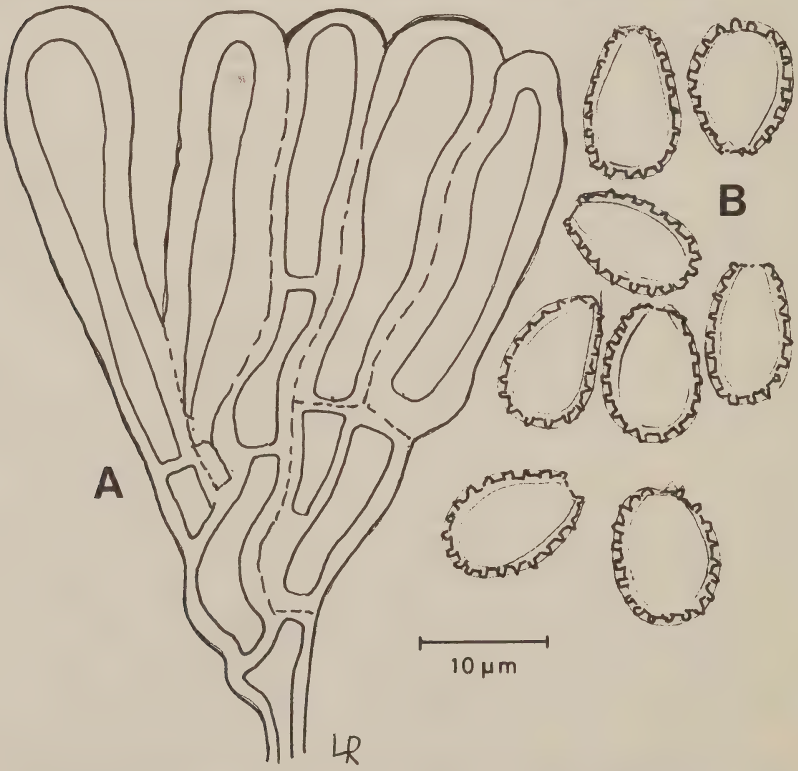

Fig. 2 G. leucocreas, A) apical cells from pileus, B) Basidiospores (from the lectotype, FH).

Thus, for the time being we consider the two species to be distinct.

In his survey of the Ganodermataceae Corner (1983:26) reported a dextrinoid reaction of the skeletal hyphae of a single *Ganoderma* specimen collected in Malaya, which he tentatively identified as *G. amazonense* Weir. Corner's collection is certainly unrelated to *G. hildebrandii* and, as he stated, the reaction is merely specific or varietal rather than generic or subgeneric. However, he also reported (op.cit.) a dextrinoid reaction in 10 *Amauroderma* species. Interestingly, although *G. hildebrandii* is easily distinguished from these species by its ganodermatoid basidiospores and its shiny basidiocarp, it has in common with dextrinoid *Amauroderma* species, a thin light coloured context where brown colours are more or less absent, a dimitic hyphal structure, a central or nearly central stipe and a terrestrial habit. This habit is common in *Amauroderma* while *Ganoderma* species generally are found on wood. In addition, Patouillard (1889:69) and Bresadola (1932:1009) both noted similarities between *G. hildebrandii* and *Amauroderma*. The distinction between the two genera is based solely on the shape of the basidiospores and may not be natural (Furtado 1965, 198, Corner 1983).

G. hildebrandii and *G. leucocreas* should be added to Corner's list (1983:35-36) of species intermediate between the two genera. In conclusion, further cultural and molecular studies may eventually clarify the interrelationship between *G. hildebrandii* and *G. leucocreas*. DNA studies may also help to resolve the phylogenetic position of *G. hildebrandii* in Ganodermataceae

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TOMENTELLA GIGASPORA SP. NOV.

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ABSTRACT

Tomentella gigaspora Hjortst. & Ryv. is described, characterized by a black, odontoid basidioma and spores 14-17 µm in diameter.

INTRODUCTION

The genus *Tomentella* has been monographed by Larsen (1974) and the knowledge of the genus, especially in North America is fairly good. Thus, it came as a surprise when one of us (L.R.) in Costa Rica found a striking black odontoid species with large brown spiny spores, far outside the range of size normally encountered in the genus. An examination in the laboratory confirmed the preliminary generic determination as the hyphae and the immature basidia reacted with a strong green colour in KOH, a rather typical character in *Tomentella*, see for example Larsen (1974:60) and Hjortstam & Ryvarden 1988. No species described in Larsen (1974) could match the large spores and the odontioid black basidiocarp seen in the Costa Rican collection, and it is herewith described as new.

Tomentella gigaspora Hjortstam & Ryvarden nov. sp.
Basidioma resupinatum, adnatum, colliculosum vel postremo conspicue odontioides, sordidum vel denigratum, aculeis obtusis, circa 0.2-0.3 (-0.4) µm longis et 3-4/mm.; systema hyphale monomiticum; hyphæ fibulatæ, 3-4 µm latæ, pallide olivaceæ;

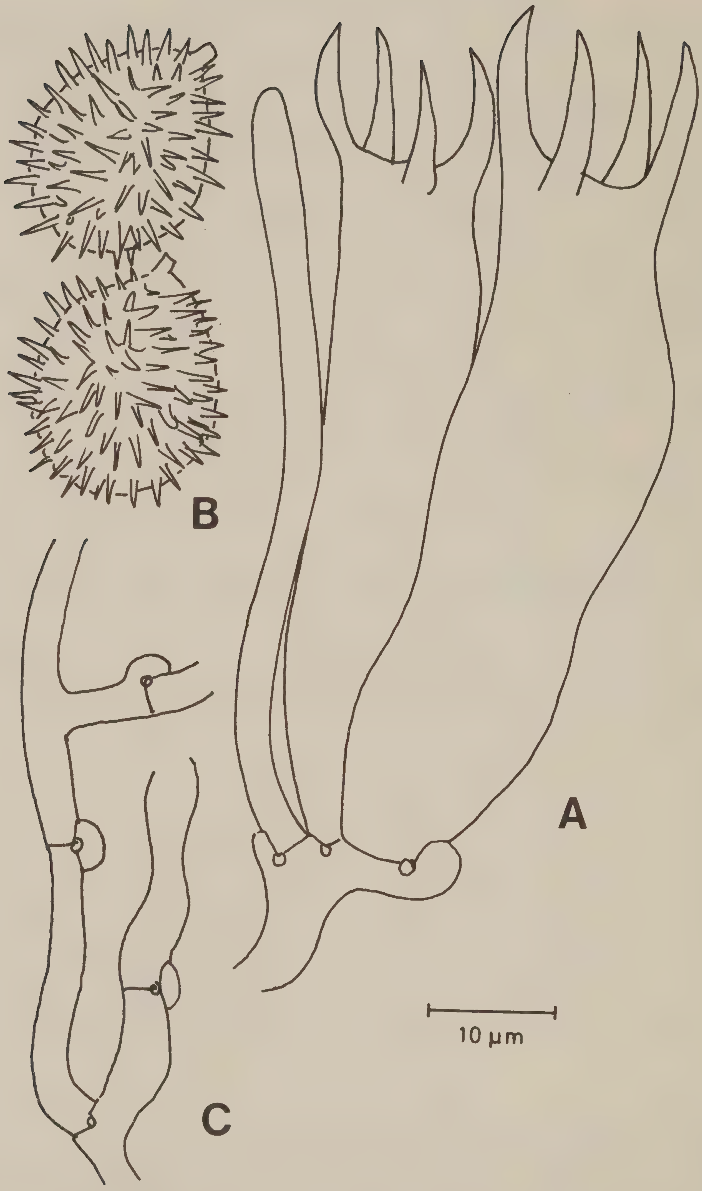

Fig. 1. *Tomentella gigaspora* A) Basidia, B, Basidiospores, C) Hyphae. From the holotype.

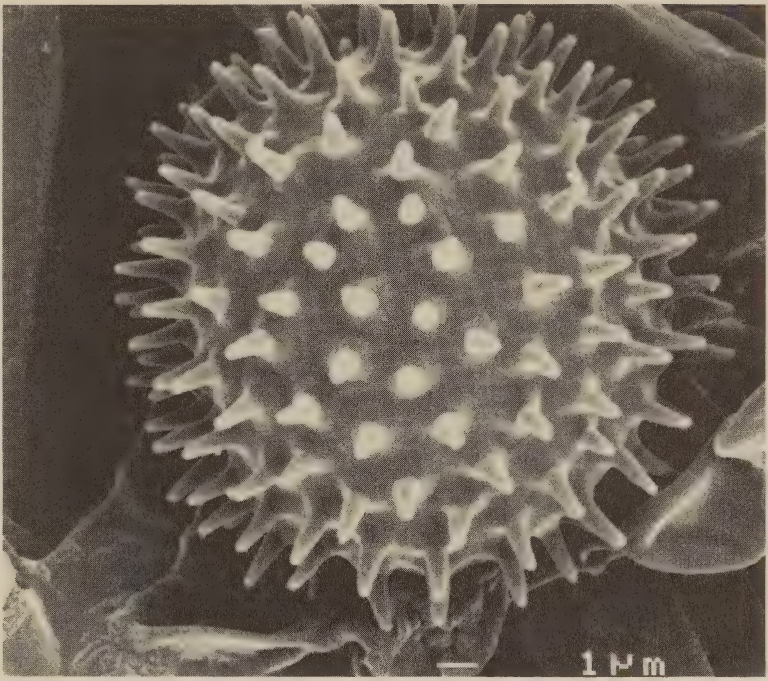

Fig. 2. Basidiospores of *Tomentella gigaspora*. Photo L. Ryvarden, from the holotype.

cystidia nulla; basidia 50-70 x 15-22 µm, 4 sterigmatibus; sporae subglobosae vel globosae, brunneolae, dense spinosae, 14-17 µm diametro, spinis circa 2 µm longis.
Holotype: Costa Rica, San Jose province, University de la Paz, Colon, 1300 m.a. s. l., 13. June 1991, L. Ryvarden 29688 (O).
Isotypes: GB, K, TAA and USJ.

Basidiome resupinate, adnate, colliculose to odontoid, black, dull, widely effused, up to 10 cm in longest dimension, up to 2 mm thick, rather fragile when dry.
Hyphal system monomitic; all hyphae with clamp-connexions, 3-4 µm wide, often branched in wide to right angles, pale olivaceous in water, most hyphae, especially in the subhymenium, becoming green in 3% KOH.

Cystidia absent, but some paraphysoid hyphae mixed with the basidia occur.
Basidia with 4 sterigmata and basal clamp-connexion, 50-70 x 15-22 µm, individual sterigmata up to 12 µm long.
Basidiospores globose, brownish in KOH, densely spiny, 14-17 µm in diam (excluding the aculei), individual spines up to 2 µm long.
Substrate. On dead deciduous wood.
Known only from the type locality.

DISCUSSION

The very large spores and the black basidiocarp make this a characteristic species. The largest spores we have seen described for a *Tomentella* species, are those of *T. ruttneri* Litsch. and *T. bresadolae* (Brinkm. in Bres.) Bourd. & Galz. which normally have spores up to 12-14 µm in diam (including the aculei), thus smaller than those reported here. Further, the spores of *T. gigaspora* are more densely echinulate than the spores of the two species mentioned above.

U. Köljalg of the University of Tartu, Estonia, who is studying the genus *Tomentella* in Estonia, kindly examined a part of the holotype and pointed out that the spores of *T. gigaspora* are golden brown in 5% KOH compared with dull brown for the two other species. He also added that in general the hyphae of *T. bresadolae* and *T. ruttneri* are up to 6 to 7 µm wide and pale brown, while those of *T. gigaspora* are narrow, i.e. 3-4 µm in diameter and almost hyaline.

ACKNOWLEDGEMENTS

Urmas Köljalg, University of Tartu, Estonia has examined the holotype and contributed valuable comments. M. Larsen, United States Department of Agriculture, Forest Service, Intermountain Research Station, Moscow, Idaho, has kindly read the manuscript and suggested improvements for which we are grateful.

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STECCHERICIUM ACANTHOPHYSIUM (HERICIACEAE, APHYLLOPHORALES) NOV. SP.

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ABSTRACT

Stecchericium acanthophysium from Japan, is described as new, characterized by a cinnamon to yellow, pileate and hydnoid basidiocarp, dimitic hyphal system, amyloid, finely ornamented spores and abundant acanthophyses.

INTRODUCTION.

Stecchericium was described by D. A. Reid (1963) based on *Steccherinum fistulatum* as type species. The genus is characterized by basidiocarps with a hydnoid hymenophore, a dimitic hyphal system with clamped generative hyphae and skeletal hyphae, variable types of cystidia in the hymenium and amyloid warted spores. Reid pointed out the obvious relationships to other genera of the Hericiaceae Donk where most species have hydnoid basidiocarps and amyloid warted spores and with a variable occurrence of gloeocystidia in the hymenium. In macromorphology *Stecchericium* comes close to *Steccherinum* S. F. Gray which however, has smooth non-amyloid spores.

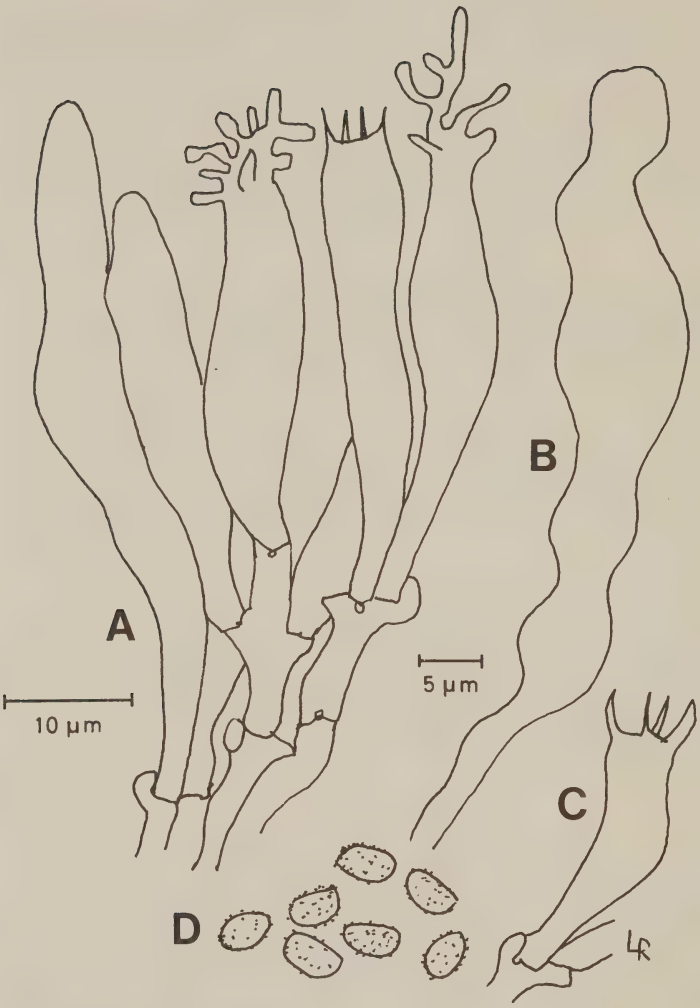

Fig. 1. *Steccherícium acanthophysium*, A) Part of the hymenium with gloeocystidia, acanthophyses and basidium, B) Gloeocystidium, C) Basidium, D) Basidiospores. From the holotype.

Later Maas Geesteranus (1966 and 1971) treated *Steccherícium* in detail and showed that the *Steccherícium seriatum* (Lloyd) Maas Gest. is the correct name for the type species. He also described (1971) *Steccherícium rusticum* Maas Geest. from Singapore.

Corner (1989) discussed the taxonomic relationship between *Steccherícium* and related genera in Hericiaceae such as *Wrightoporia* (poroid with dextrinoid skeletal hyphae in most species) and *Amylonotus* Ryv. (amyloid with brown basidiocarps) and concluded that they both should be merged with *Steccherícium*. Corner (op. cit) also supplied a key to all species then known in the genus including his recent transfers from the genera mentioned above.

Wrightoporia is undoubtedly closely related to *Steccherícium* but we feel that the poroid hymenophore and the dextrinoid skeletal hyphae are convenient characters to keep the two genera separate for the time being. Modern DNA technique now makes it possible to elucidate generic relationship in a completely different way and further investigations in the Hericiaceae with this technique may settle the question on what is a true relationship and what are cases of biological convergence. We still are completely at a loss about which character are the primitive ones and which are the advanced ones. Thus, we feel that Corner's approach is a bit premature under the prevalent circumstances.

A parallel to the situation of what is discussed above is the case of *Junghuhnia* (poroid) and *Steccherinum* (hydnoid). Everyone familiar with the two genera accept the very close relationship between them. Never the less, they are kept separately because of the arguments mentioned above, and also partly of convenience and to avoid too many nomenclaturial transfers which are needed should the two genera be merged.

Some years ago one of us (TH) collected an unknown cinnamon pileate hydnoid species in Okinawa. Microscopical examination showed it to be a typical *Steccherícium* with typical skeletal hyphae and small ornamented amyloid spores, but also with numerous large acanthophyses penetrating the hymenium from the trama. Corner's key gave no clue to its identity and it is described below as a new species.

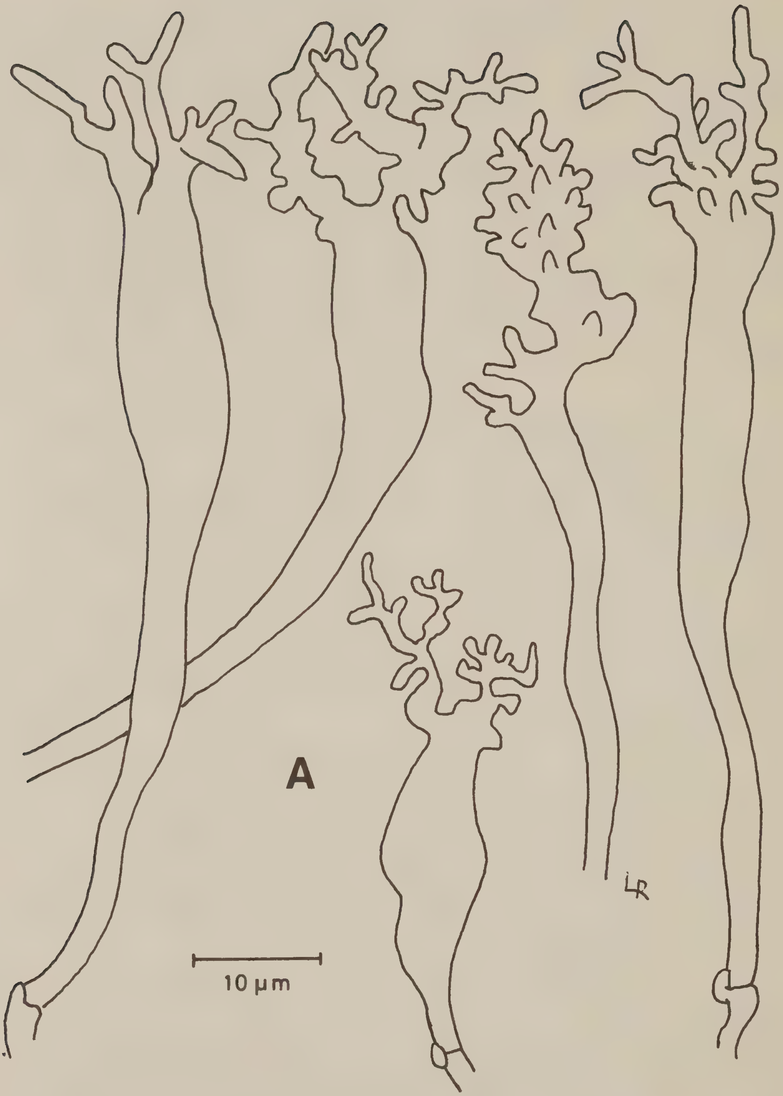

Fig. 2. *Steccherícium acanthophysium*, A) Acanthophyses. From the holotype.

Stecchericium acanthophysium Hattori & Ryv. nov. sp. Fig. 1 & 2
Fructificatio sessilia, pileus cinnamomeus, glabrus, hymenophorum hydnoidea,flavum ad pallide cinnamomeum, contextus flavum vel cinnamomeum, systema hypharum dimiticum, hyphae generatoriae fibulatae, hyphae skeletales pallide flavescens, acanthophyses praesentes, basidiosporae hyalinae, verrucosae, amyloideae, 3.5-4.5 x 2.5-3 µm.

Holotype: Japan, Okinawa Pref. Iriomote Island. Aira River 5. February 1992. Leg. T. Hattori, TFM-F-16598 (herb. TFM, isotypes in K and O).

Basidiocarp pileate to effused reflexed, annual, projecting pileus up to 15 mm wide, 30 mm long and to 10 mm thick at the base, upper surface dull, smooth to finely adpressed velutinate in zones, slightly sulcate in concentric zones, pale cinnamon with a yellow tint, becoming reddish with KOH and without reaction with Melzer's reagent, lower surface densely hydnoid, individual spines up to 3 mm long, round to slightly flattened, pale cinnamon, context duplex with a thin dense yellow zone above the attachment of the spines, the rest of the context of a looser consistency and pale cinnamon.

Hyphal system dimitic, generative hyphae with clamps, hyaline, richly branched, 2-4(5) µm in diam, skeletal hyphae straight, thick-walled, pale yellow in KOH, without reaction in Melzer's reagent, 2-5 µm wide.

Gloeocystidia rare, smooth, tubular to moniliform, up to 120 x 12 µm.

Acanthophyses abundant, hyaline, mostly arising in the subhymenium or trama and bending into the hymenium, but only slightly projecting beyond it, some acanthophyses also arising in the subhymenium at the same level as the basidia, strongly branched in the top, often from rounded and inflated tuberances, from base to apex up to 160 µm, no reaction in Melzer's reagent.

Basidia clavate with a basal clamp and 4 sterigmata, 18-25 x 4-6 µm.

Basidiospores broadly ellipsoid, thin-walled, finely ornamented when viewed in Melzer's reagent, looking smooth in KOH, distinctly amyloid in Melzer's reagent, 3.5-4.5 x 2.5-3 µm.

Substrate. Known only from unknown hardwood.

Remarks. This is a conspicuous species with its pale cinnamon to yellow spiny basidiocarp, large acanthophyses with a long tapering base and small, amyloid and ornamented spores.
Specimens examined: The holotype as cited above, Okinawa, prefecture, Ishigaki Isl., T. Hattori 16644 (TFM, O), same locality, 25 June 1994, leg. T. Hattori, TFM-F-17201 (TFM, TNS, K); Ishigaki Island, Banna, 2 Oct., 1993, leg. T. Hattori, TFM-F-16955; same locality 24 June 1994, leg. T. Hattori, TFM-F-17177.

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DACTYLELLA CLAVATA SP. NOV., A HYPHOMYCETE FROM XISHA ISLANDS, CHINA

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During an examination of soil samples taken from Xisha islands, Hainan province, for the occurrence of nematode-trapping fungi, a *Dactylella* species with a clavate conidia was different from other species of the genus (Zhang et al., 1994). We therefore propose a new species, *Dactylella clavata*, to accommodate this organism.

Dactylella clavata sp. nov. (Figs 1-2)

Coloniis in extracto granorum zeae maydis cum agar albidis. Mycelium sparsum, hyphis sterilibus incoloratis, septatis, 1.2 μm latis. Conidiophoris incoloratis, erectis, septatis, conidiis unicis, ex apicibus conidiophororum vel ramunculorum saepe ferentibus. Conidiis hyalinis, clavatis, 20-37-60 μm longis, 4-6-8 μm latis, 1-7, praecipue 3-5 septatis. Chlamydosporis in culturis vetustis gerentibus.

Habitat ex solo *Cocos nusifera* L., Yongxing, Xisha insula, 16-IV-1993, Dr. Fa-Jun Chen, X19-1, Typus HMAS 69236.

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[1] corresponding author

Colonies on CMA whitish, slow-growing extending a diameter of 2.8 cm within one week at 25℃, producing sparse aerial mycelium. Conidiophores hyaline, erect, septate, simple or with several branches, 10-500 µm long, 1.5 µm wide at the base, 0.7 µm at the tip. A single conidium formed at the apex of the conidiophore or its branches. Conidia hyaline, clavate, round at the distal end, tapering toward the truncate base, 1-7, mainly 3-5 septa, 20-37-60 × 4-6-8 µm. Spherical or broadly ellipsoidal chlamydospores presented in older cultures. There was no predacious ability observed when the culture was challenged with nematode *Paragrellus redivivus.*

The fungus was isolated from the soil of *Cocos nucifera* L. collected from Yongxing, Xisha islands. The type specimen is deposited in the Herbarium Mycologicum, Instituti Microbiologici, Academiae Sinicae (HMAS 69236)

Dactylella clavata resembles *Dactylella ramosa* Matsushima (Mat-sushima, 1971), *D. rhopalota* Drechsler (Drechsler, 1943) and *D. tenuis* Drechsler (Drechsler, 1937) in conidiophore branches and conidia shape. While *D. rhopalota* is with successive prolongations of conidiophore branches and mainly 7-septate conidia, *D. ramosa* with 3-9 septa and somewhat narrow (4.2-6.0 µm) conidia and *D. tenuis* with mainly 3-septate conidia.

More than 30 soil samples from Xisha islands were examined for the nematode-trapping fungi. Due to the samples had been stored in room temperature for several months, *D. clavata* is the only *Dactylella* species encountered.

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来自西沙群岛丝孢菌一新种——棒孢指隔孢

本文报道来自西沙群岛永兴岛指隔孢一新种——棒孢指隔孢(*Dactylella clavata* Gao, Sun et Liu), 该新种主要特征为分生孢子梗分枝、分生孢子棒状、1—7分隔(3—5分隔为主)、20 - 60 (37) × 4 - 8 (6)μm。

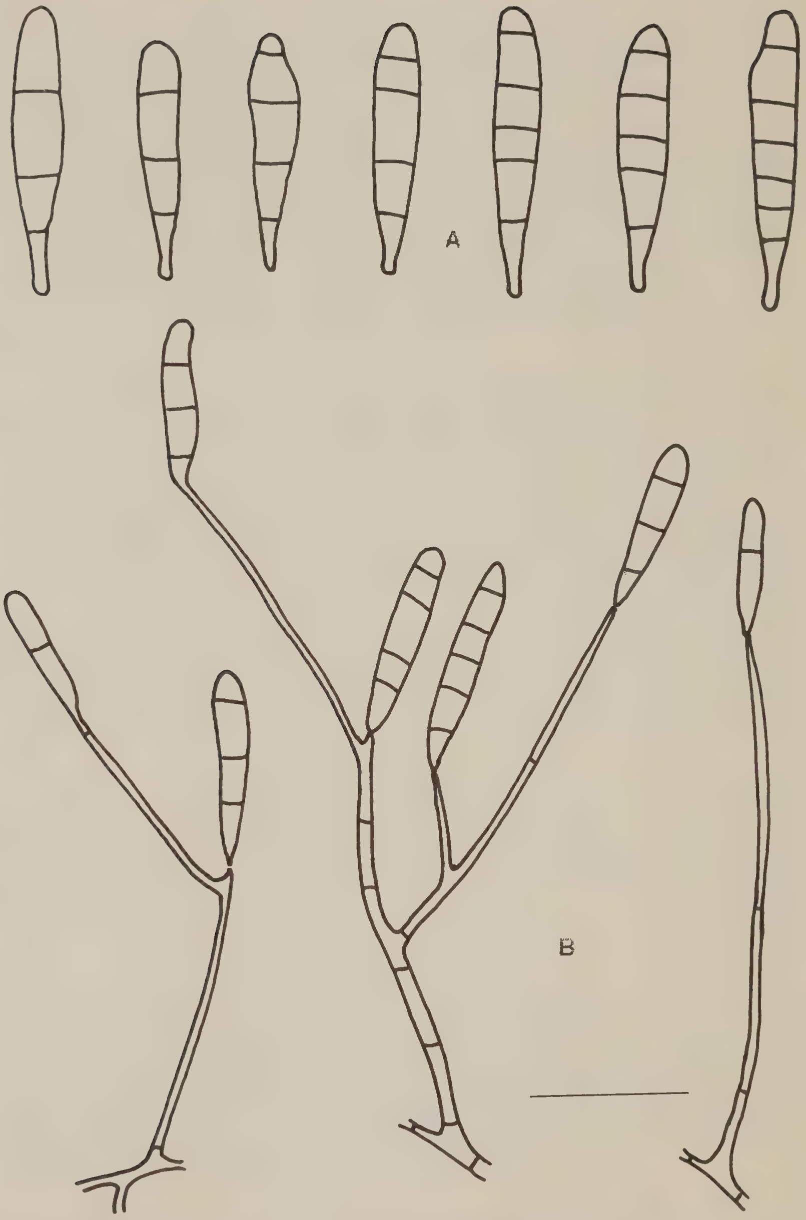

Fig. 1. *Dactylella clavata*. A. conidia with 3-6 septa. B. simple and branched conidiophores. *Bar=25 µm.*

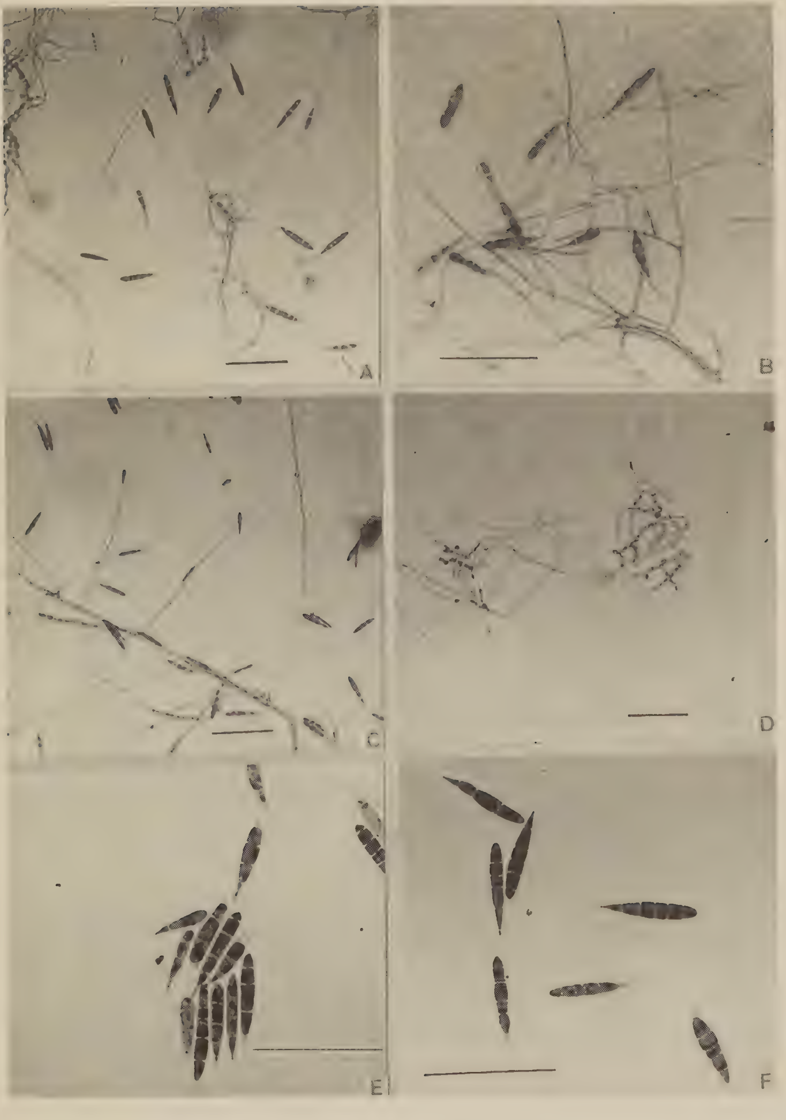

Fig. 2. *Dactylella clavata.* A, B, and C. conidiophores. D. chlamydospores. E, and F. conidia. *Bar=25 µm.*

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TAXONOMICAL STUDIES ON USTILAGINALES. XIII.*

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ABSTRACT

The following groups of Ustilaginales were studied: Entyloma on Hydrocotyle; Tilletia on Eragrostis, Eragrostiella and Brachypodium; smut fungi of Trachypogon and Eriochloa; and further members of the genus Endosporisorium.

NEW SPECIES proposed: Anthracoidea grallatoriae K. Vánky (type on Carex grallatoria); Entyloma novae-zelandiae E. McKenzie & K. Vánky (type on Hydrocotyle heteromeria and H. novae-zelandiae); Sporisorium exsertiformum K. Vánky (type on Themeda australis); Sporisorium trachypogonicola K. & C. Vánky (type on Trachypogon plumosus); Sporisorium trachypogonis-plumosi K. Vánky (type on Trachypogon plumosus); Tilletia brachypodii-mexicani K. Vánky (type on Brachypodium mexicanum); Tilletia colombiana K. Vánky (type on Brachypodium mexicanum); Tilletia eragrostiellae K. & C. Vánky & N. D. Sharma (type on Eragrostiella bifaria).

NEW NAME proposed: Sporisorium zundelianum K. Vánky for Ustilago trachypogonis Zundel, (not Sporisorium trachypogonis (Zundel) K. Vánky; type on Trachypogon plumosus).

NEW COMBINATIONS proposed: Endosporisorium effusum (H. & P. Sydow) K. Vánky, based on Ustilago effusa (type on Andropogon muricatus); Endosporisorium pachycarpum (H. Sydow) K. Vánky, based on Sorosporium pachycarpum (type on Rottboellia ophiuroides); Sporisorium mixtum (Massee) K. Vánky, based on Tilletia mixta (type on Eriochloa annulata); Sporisorium trachypogonis (Zundel) K. Vánky, based on Spacelotheca trachypogonis (type on Trachypogon vestitus).

SYNONYM: Tolyposporium juncophilum McAlpine is a synonym of Urocystis junci Lagerheim.

EXCLUDED SPECIES: Sphacelotheca dinebrae Mundkur (type on Dinebra retroflexa) is an Ustilaginoidea sp. (Hyphomycetes).

LECTOTYPES are selected for: Tilletia brachypodii Mundkur, and Tilletia mixta Massee (= Sporisorium mixtum).

Revising smut fungi obtained in exchange from Japan (Sapporo, SAPA), a specimen of "Cintractia caricis" on Carex grallatoria Max., a peculiar sedge being the only member of the sect. Grallatoriae Kük. of the subgen. Carex, turned out to be an undescribed Anthracoidea species:

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* Part 106 in the series "Studies in Heterobasidiomycetes" from the Botanical Institute, University of Tübingen.

Anthracoidea grallatoriae K. Vánky, **sp. nov.**

Typus in matrice Carex grallatoria Maxim. (det. J. Ohwi), Japan, Tosa Prov., Mt. Kunimi, 1.VI.1912, T. Yoshinaga. Holotypus in Herbario Ustil. Vánky (HUV 16689!), isotypus in SAPA.

Sori (Fig. 1) in ovariis in inflorescentia dispersi, sicut corpora ovoidea, nigra, dura evoluti, cca. 1 x 1,3–1,8 mm, in superficie pulverei, a glumis et ab utriculis longitudinaliter disscissis cooperti. Sporae (Figg. 3, 4) forma magnitudineque variabiles, ovoideae, subpolyangulariter irrgulares, saepe elongatae, parum depressae, 12–24 x 20–32(–40) µm, mediocriter usque fusco-rufobrunneae; paries inaequaliter incrassatus, 1–3(–4) µm crassus, plerumque 1–4 gibberis internis bene evolutis, et nonnunquam etiam protuberantiis et maculis refractivis; superficie dense verruculosa usque verrucosa et propter hoc extrema linea sporarum leniter undulata usque serrulata, saepe 2–3 verrucae partim confluentes.

Sori (Fig. 1) in ovaries, scattered in the inflorescence, as ovoid, black, hard bodies, ca. 1 x 1.3–1.8 mm, powdery on the surface, partly enclosed by the glumes and the longitudinally splitting utricles. Spores (Figs. 3, 4) variable in shape and size, ovoid, subpolyhedrally irregular, often elongated, slightly flattened, 12–24 x 20–32(–40) µm, medium to dark reddish-brown; wall unevenly thickened, 1–3(–4) µm thick, usually with 1–4 well-developed internal swellings and sometimes also with protuberances and light-refractive spots; surface densely verruculose to verrucose causing the spore profile to appear finely wavy to serrulate, often 2–3 warts partly confluent.

Anthracoidea grallatoriae differs from A. caricis (Pers.) Bref. (on members of the subgen. Carex, sect. Acrocystis = Montanae), i. a., in having larger, more elongated spores with well-developed internal swellings. The presence of the 1–4 well-developed internal swellings and the relatively few protuberances and light-refractive spots in A. grallatoriae differentiate this smut from A. irregularis (Liro) Boidol & Poelt (on members of the subgen. Carex, sect. Digitatae). The spores of A. pseudirregularis U. Braun (on Carex pallescens L., subgen. Carex, sect. Porocystis) are shorter (20–25(–30) µm long) than those of A. grallatoriae, and internal swellings in A. pseudirregularis are only rarely present.

The finding of A. grallatoriae also supports Nannfeldt's statement (1979:3) in his study of Anthracoidea on Nordic Cyperaceae – Caricoideae, namely that "Hosts in taxonomically isolated positions bear as a rule smuts (Anthracoidea species, the author's note) restricted to that particular host."

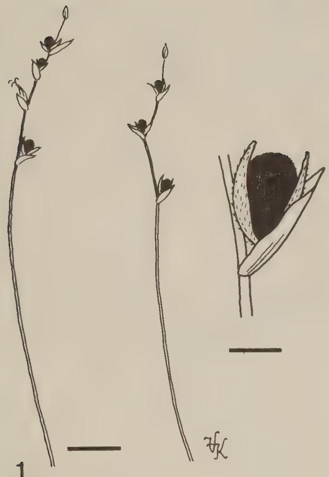
The Entyloma species of Hydrocotyle (Umbelliferae).

In connection with several specimens of a supposed new Entyloma species on two Hydrocotyle species, obtained from my friend Dr. Eric McKenzie (Auckland, New Zealand), I checked the types of the two known Entyloma species on Hydrocotyle. This comparison confirmed that the specimens from New Zealand represent an undescribed species. The descriptions of these three Entyloma species are:

Entyloma hydrocotylis Spegazzini, 1899:211.

Type on Hydrocotyle cryptocarpa Speg., Argentina, marshes near La Plata, 8.X.1890, C. Spegazzini (LPS 3356!).

Sori in the leaves as pale to reddish-brown, orbicular, flat spots of 0.5–1 mm in diameter, with indefinite margins. Spores (Fig. 5) densely crowded, subglobose, ellipsoidal to subpolyhedrally irregular due to mutual pressure, 9–13 x 9.5–17 µm, pale yellowish-brown, content often finely granular; wall two-layered, 1.5–2.5 µm thick, smooth. Conidia not reported.



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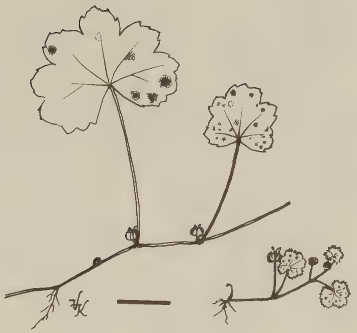

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Fig. 1. Sori of Anthracoidea grallatoriae in the ovaries of Carex grallatoria (type). Bars = 0.5 cm and 1 mm.

Fig. 2. Sori of Entyloma novae-zelandiae in the leaves of Hydrocotyle heteromeria and H. novae-zelandiae (type). Bar = 1 cm.

Entyloma fimbriatum G. W. Fischer, 1952:3.

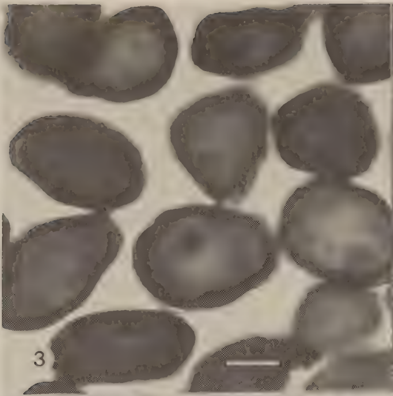
Type on Hydrocotyle ranunculoides L., USA, California, Alameda, X.1930, leg. ? (WSP 34408!).

Sori in the leaves as circular spots, up to 1 mm in diameter, "fimbriate at the margin" (namely, spots somewhat extending along the leaf-veins), brown, darker on the upper than on the lower surface. Spores globose, subglobose, ovoid to usually ellipsoidal, extremely variable in size, 10–20 x 12–24 µm in diameter, subhyaline to pale yellow, content homogenous; wall uniform, thin (0.5–0.7 µm), one-layered, smooth. Conidia not reported.

Entyloma novae-zelandiae E. McKenzie & K. Vánky, **sp. nov.**

Typus in matrice Hydrocotyle heteromeria A. Rich., New Zealand, Chatham Islands, Hapupu, 43°48’ S, 176°21’ W, alt. ca. 5 m, 9.III.1983, leg. E. H. C. McKenzie. Holotypus in Herbario Ustil. Vánky (HUV 16766!); isotypus in PDD 52062. Paratypus in matrice Hydrocotyle novae-zelandiae DC., New Zealand, South Island, Mid Canterbury Distr., Christchurch, Riccarton, Rattray St., 22.XI.1985, leg. A. J. Healy (85/83), PDD 44434, isoparatypus in Herbario Ustil. Vánky (HUV 16767!).

Sori (Fig. 2) in foliis sicut maculae amphigenae apparentes, subcirculares, diametro usque 1,5 mm, primo flavae usque flavobrunneae, serius cinereae vel nigrae, dispersae vel nonnunquam confluentes. Sporae (Fig. 6) in textum matricis immersae, saepe compressae, singulares vel nonnunquam in catenis, forma et magnitudine variabiles, globosae, subglobosae, ellipsoidales usque subpolyedriciter irregulares propter pressionem mutuam, 7–11 x 8–14,5 µm, subhyalinae usque pallide flavae, intus materiam homogeneam continentes; pariete uniformiter tenue, 0.5(–1) µm crasso, unistratoso, leve. Conidia nulla observata.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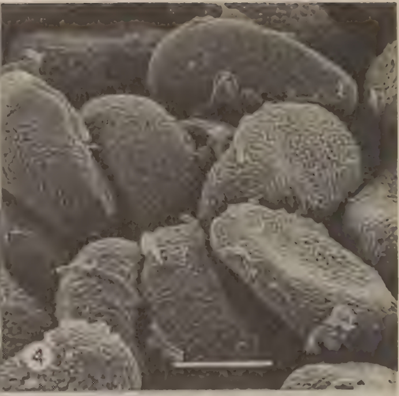
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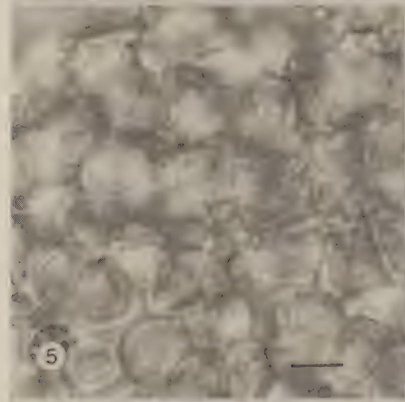
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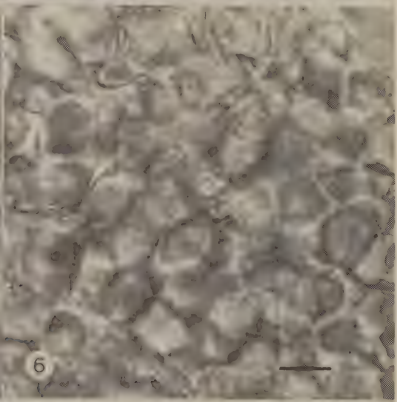
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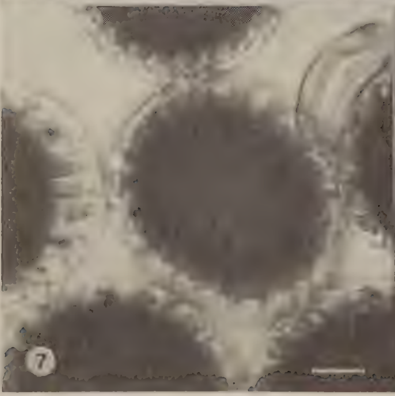
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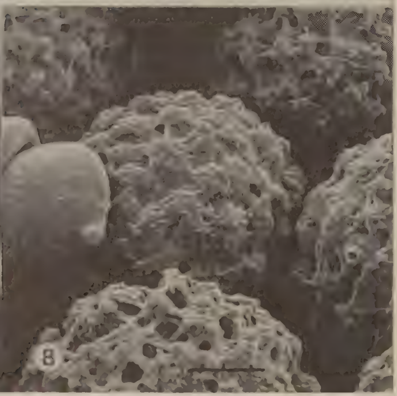
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Sori (Fig. 2) in the leaves as amphigenous, subcircular spots, up to 1.5 mm in diameter, first yellow to yellowish-brown, later turning into grey or black, scattered or sometimes confluent, with spores embedded in the host tissue, often crowded, sometimes in chains or single. Spores (Fig. 6) variable in shape and size, globose, subglobose, ellipsoidal to subpolyhedrally irregular due to mutual pressure, 7–11 x 8–14.5 µm, subhyaline to pale yellow, content homogenous; wall uniform, thin, 0.5(–1) µm in diameter, one-layered, smooth. No conidia were observed.

Entyloma novae-zelandiae differs from *E. hydrocotylis* in having somewhat smaller spores with a thin, one-layered wall and homogenous content. The spores of *E. fimbriatum* are larger than those of *E. novae-zelandiae*.

E. novae-zelandiae was reported (as *E. heteromeria*, ined.) from the Chatham Islands by McKenzie (1991:201).

Key to the *Entyloma* species of *Hydrocotyle*.

1. Spore wall two-layered, 1.5–2.5 µm thick; content granular . . *E. hydrocotylis*
– Spore wall one-layered, 0.5–1 µm thick; content homogenous 2
2. Spores 12–24 µm long . . . . *E. fimbriatum*
– Spores 8–14.5 µm long . . . . *E. novae-zelandiae*

The *Tilletia* species of *Eragrostis* and *Eragrostiella* (Gramineae).

On *Eragrostis* and *Eragrostiella* five *Tilletia* species have been described. These can be attributed to the following four species:

1. *T. eragrostidis* Clinton & Ricker, in Ricker, 1905:111. – Type on *Eragrostis glomerata* (Walt.) L. H. Dewey, USA, Mississipi, Yazo City, 8.IX.1904, S. M. Tracy (BPI 172896!).

2. *T. transvaalensis* Zundel, 1931:299. – Type on *Eragrostis aspera* (Jacq.) Nees, Union of South Africa, Transvaal, Zebediela distr., Mucklenburg, 6.VI.1913 (on the label "6.VI.1930"), G. W. Wearing (HCIO 10144!).

T. bangalorensis Pavgi & Thirumalachar, in Thirumalachar & Pavgi, 1956:285. – Type on *Eragrostis tenuifolia* Hochst. ex Steudel, India, Bangalore, 15.X.1952, H. C. Govindu (HCIO 20998!). Durán & Fischer (1961:113) demonstrated that *T. bangalorensis* is conspecific with and thus a synonym of *T. transvaalensis*.

3. *T. poonensis* Thirumalachar & Pavgi, in Durán & Fischer, 1961:94; Thirumalachar & Pavgi, 1967(1968):26. – Type on *Eragrostiella bifaria* (Vahl) Bor, India, Maharashtra State, Pune (Poona), Ganeshkind, 10.X.1954, M. J. Thirumalachar (1246).

4. *T. durangensis* R. Durán, 1970:1101. – Type on *Eragrostis mexicana* (Hornem.) Link, Mexico, Durango, 71.2 mi N. W. of J. G. Aguilera off Hwy. No. 39, 21.X.1969 (WSP 58554; isotype in HUV 14446!).

A *Tilletia* on *Eragrostiella bifaria*, collected in India, turned out to be distinct and it is described as:

Figs. 3, 4. Spores of *Anthracoidea grallatoriae* (type) in LM and in SEM.
Fig. 5. Spores of *Entyloma hydrocotylis* (type) in LM.
Fig. 6. Spores of *Entyloma novae-zelandiae* (type) in LM.
Figs. 7, 8. Spores and sterile cells of *Tilletia eragrostiellae* (type) in LM and in SEM. Bars = 10 µm.

Tilletia eragrostiellae K. & C. Vánky & N. D. Sharma, **sp. nov.**
Typus in matrice _Eragrostiella bifaria_ (Vahl) Bor (det. S. G. Pradhan, BSI), India, Madhya Pradesh, 9 km S. E. Jabalpur, Tropical Forest Research Institute, 23°07' N, 80°00' E, alt. ca. 390 m, 13.X.1992, leg. N. D. Sharma, S. R. Singh, R. P. Mishra, M. B. Nagar and C. & K. Vánky (unacum _Sporisorium_ sp.). Holotypus in Herbario Ustil. Vánky (HUV 15805!); isotypi in Vánky, Ust. exs. no. 929.

Sori (Fig. 9) in ovariis dispersis, subglobosi usque ovoidei, 1–2,5 mm longi, atrobrunnei primo pericarpio cooperti, pericarpio rupto massam sporarum nigram, pulveream, cum cellulis sterilibus intermixtam ostendentes. Sporae (Figg. 7, 8) globosae, subglobosae usque ovoideae, 36–52 x 40–60(–65) µm (simul cum ornamento et vagina tenui, hyalina), atro-rufobrunneae, opacae; pariete verrucis densis, truncatis vel subconicis, 4–8(–9) µm altis (in SEM, secus per vaginam siccam absconditis). Cellulae steriles ovoideae, vel parum irregulares, saepe collapsae, sporis minores (20–44 µm longae), subhyalinae; pariete 3–6,5 µm crasso, levi.

Sori (Fig. 9) in scattered ovaries, subglobose to ovoid, 1–2.5 mm long, dark brown, at first covered by the pericarp which ruptures disclosing the black, powdery mass of spores intermixed with sterile cells. Spores (Figs. 7, 8) globose, subglobose to ovoid, 36–52 x 40–60(–65) µm (including ornamentation and the thin, hyaline sheath), dark reddish-brown, opaque; wall provided with densely situated, truncate or subconical warts, 4–8(–9) µm high (in SEM, these are hidden by the dried sheath). Sterile cells ovoid or slightly irregular, often collapsed, smaller than the spores (20–44 µm long), subhyaline; wall 3–6.5 µm thick, smooth.

Key to the _Tilletia_ species of _Eragrostis_ and _Eragrostiella_.

1. Spores reticulate	_T. durangensis_
– Spores otherwise sculptured	2
2. Spores with conical warts; spores 19–25 µm	_T. transvaalensis_
– Spores with subconical or truncate warts; spores larger	3
3. Spores 36–60(–65) µm, warts 4–8(–9) µm high	_T. eragrostiellae_
– Spores smaller, warts lower	4
4. Spores 28–37 µm, warts truncate, 2.5–4.2 µm high	_T. eragrostidis_
– Spores 17–31 µm, warts subconical or truncate, 1.4–2.8 µm high	_T. poonensis_

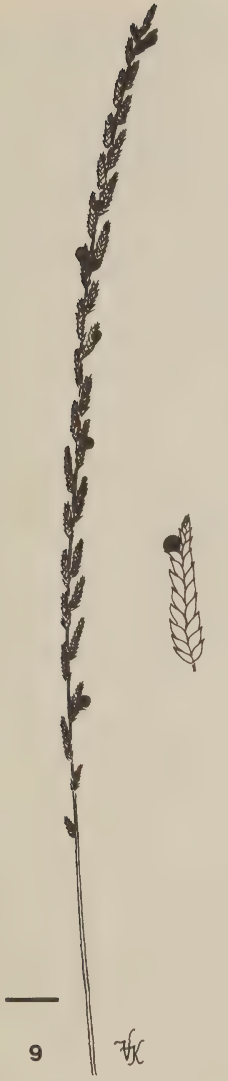
The _Tilletia_ species of _Brachypodium_ (Gramineae).

Three _Tilletia_ species are known on _Brachypodium_:

1. _T. olida_ (Riess) Schröter, in Cohn, 1877:366 (based on _Uredo olida_), type on _Brachypodium pinnatum_ (L.) Beauv. (Syn.: _T. endophylla_ de Bary, type on _B. pinnatum_).
2. _T. brachypodii_ Mundkur, 1944:51, type on _B. sylvaticum_ (Hudson) Beauv.
3. _T. brachypodii- ramosi_ Zogg, 1967:53, type on _B. ramosum_ (L.) Roemer & Schultes (= _B. retusum_ (Pers.) Beauv.).

Two South American collections of _Tilletia_, in the seeds of _Brachypodium mexicanum_, turned out to be two additional species:

Tilletia brachypodii-mexicani K. Vánky, **sp. nov.**
Typus in matrice _Brachypodium mexicanum_ (Roemer & Schultes) Link, Venezuela, Estado Mérida, ca. 52 km E. urbe Mérida, Mts. Cordillera de Mérida, Sierra Nevada, pr. lacum Laguna Negra, 8°46' N, 70°46' W, alt. ca. 3550 m., 2.XII.1993, leg. R. Berndt, C. & K. Vánky. Holotypus in Herbario Ustil. Vánky (HUV 16007!); isotypi in VEN, VIA and in Vánky, Ust. exs. no. 928.



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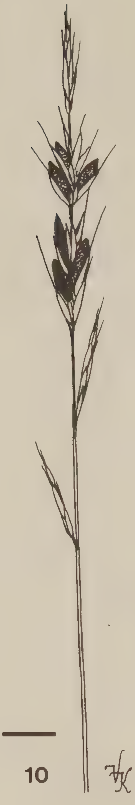

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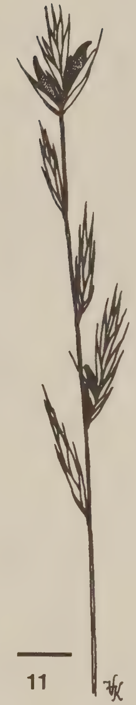

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Fig. 9. Sori of Tilletia eragrostiellae in the ovaries of Eragrostiella bifaria (type).
Fig. 10. Sori of Tilletia brachypodii-mexicani in the ovaries of Brachypodium mexicanum (type).
Fig. 11. Sori of Tilletia colombiana in the ovaries of Brachypodium mexicanum (type)
Bars = 1 cm.

Sori (Fig. 10) in seminibus, tumefacti, elongati, versus apices attenuati, 2–4 x 8–12 mm, primo virides deinde brunnei, per fissuram longitudinalem massam nigram, pulveream sporarum simul cum cellulis sterilibus intermixtis ostendentes. Solum semina nonnulla unius inflorescentiae affecta. Sporae (Figg. 12, 13) globosae, subglobosae usque late ellipsoideae, 17–22(–24) x 17,5–24(–26) µm, chocolatabrunneae usque opacae, dense verrucosae, conspicue sine involucro. Verrucae in visu mediano projectiones 1–2,5 µm altae, obtusae vel conicae. Sporae raro breviter, hyalyne appendiculatae. Cellulae steriles subglobosae, ovoideae vel irregulares, interdum breviter appendiculatae, 14–20(–24) x 14–25(–29) µm in diam., hyalinae, pariete 2,5–4 µm crasso, levi.

Sori (Fig. 10) in seeds, swollen, elongated, tapering toward their ends, 2–4 x 8–12 mm, first green later brown, rupturing longitudinally to expose the black, pulverulent mass of spores intermixed with sterile cells. Only a few seeds of an inflorescence are affected. Spores (Figs. 12, 13) globose, subglobose to broadly ellipsoidal, 17–22(–24) x 17.5–24(–26) µm, chocolate-brown to opaque, densely verrucose, sheath apparently lacking. Warts in median view appear as 1–2.5 µm long, blunt or conical projections. Spores rarely with a short, hyaline appendage. Sterile cells subglobose, ovoid or slightly irregular, sometimes with a short appendage, 14–20(–24) x 14–25(–29) µm in diameter, hyaline; wall 2.5–4 µm thick, smooth.

Tilletia colombiana K. Vánky, **sp. nov.**

Typus in matrice Brachypodium mexicanum (Roemer & Schultes) Link, Colombia, Departamento de Cundinamarca, "km 32 en la via Zipaquira – Pacho", 8.VI.1976, leg. L. A. Molina (87), comm. P. Buriticá Cespedes. Holotypus in Herbario Ustil. Vánky (HUV 7093!), isotypus in ICA.

Sori (Fig. 11) in seminibus, tumefacti, elongati, late fusoidei, 1,5–3 x 6–9 mm, primo virides, maturi brunnei, per fissuram longitudinalem massam atrobrunneam, pulveream sporarum simul cum cellulis sterilibus intermixtis ostendentes. Solum semina nonnulla inflorescentiae ejusdem affecta. Sporae (Figg. 14, 15) globosae, subglobosae usque late ellipsoideae, 13–18 x 13,5–20 µm, flavidobrunneae, dense verrucosae, conspicue sine involucro. Verrucae in visu mediano projectiones 1–1,5 µm altae, acutae. Cellulae steriles subglobosae, ovoideae vel parum irregulares, in speciminibus senilibus collapsae, 12–23 x 14–30 µm in diam., hyalinae, pariete 1,5–2,5 µm crasso, levi.

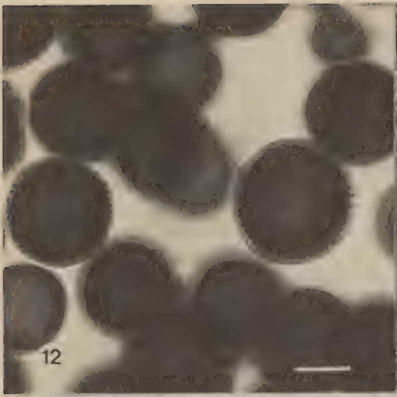
Sori (Fig. 11) in seeds, swollen, elongated, broadly fusiform, 1.5–3 x 6–9 mm, first green, at maturity brown, rupturing longitudinally to expose the dark brown, pulverulent mass of spores intermixed with sterile cells. Only a few seeds of an inflorescence are affected. Spores (Figs. 14, 15) globose, subglobose to broadly ellipsoidal, 13–18 x 13.5–20 µm, yellowish-brown, densely verrucose, sheath apparently lacking. Warts in median view appear as 1–1.5 µm long, pointed projections. Sterile cells subglobose, ovoid or slightly irregular, collapsed in old specimens, 12–23 x 14–30 µm in diameter, hyaline; wall 1.5–2.5 µm thick, smooth.

T. colombiana has smaller and lighter spores than T. brachypodii-mexicani.

Figs. 12, 13. Spores and sterile cells of Tilletia brachypodii-mexicani (type) in LM and in SEM. Bars = 10 µm.

Figs. 14, 15. Spores and sterile cells of Tilletia colombiana (type) in LM and in SEM. Bars = 10 µm.

Figs. 16, 17. Spores and sterile cells of Sporisorium trachypogonis-plumosi (type) in LM and in SEM. Bars = 10 µm.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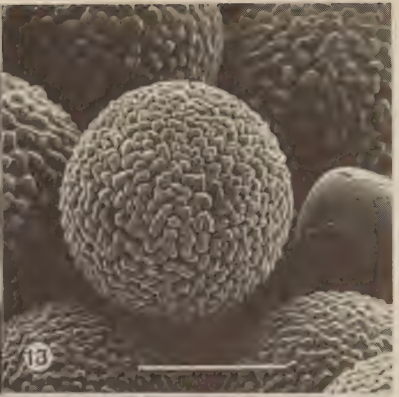
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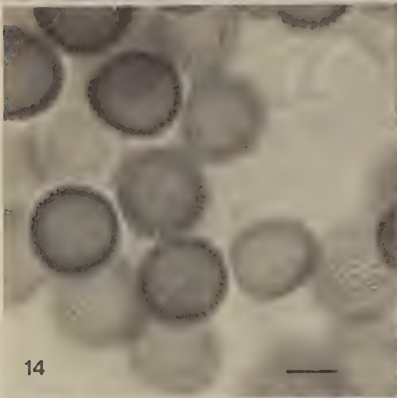
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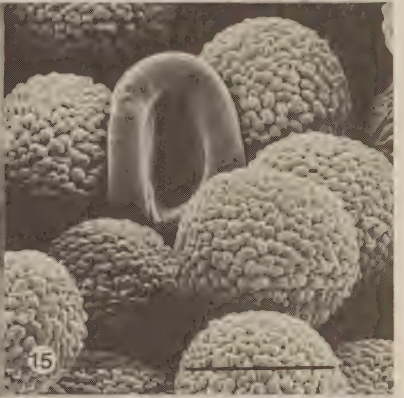
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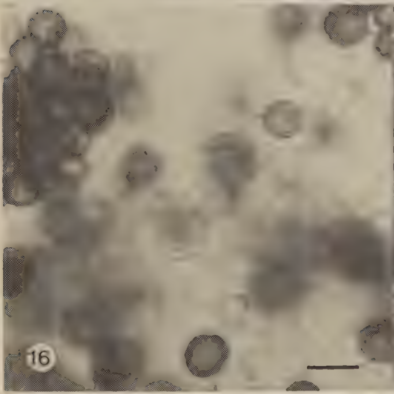
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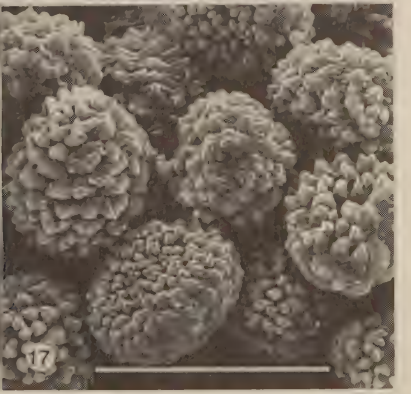
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Tilletia brachypodii Mundkur, 1944:51.
Neovossia brachypodii (Mundkur) Mundkur & Thirum. in Thirumalachar & Mundkur, 1951:7. – Lectotype on Brachypodium sylvaticum (Hudson) Beauv., India, Punjab, Simla, (selected here) X.1942, K. M. Dutt (HUV 5758!). Isolectotypes in Herb. crypt. Ind. Orient. exs. II. Indian Ust. 9. Syn- and topotypes: 17.XI.1941 & 23.XI.1942, K. M. Dutt (HCIO 10016!).

Sori in the swollen ovaries, 1.5–3 x 7–15 mm, covered by the light brown pericarp that ruptures exposing the black, semiagglutinated to pulverulent mass of spores intermixed with sterile cells. Spores globose, subglobose to broadly ellipsoidal, 16–21 x 16–22.5(–24) µm (including the 1.5–3(–4) µm thick hyaline sheath but not the often present mamilla or appendage) or 13.5–16 x 14–17.5 µm without sheath, reddish-brown, in LM, in surface view foveolate-cerebriform, in median view appearing obscurely verrucose-echinulate, in SEM irregularly, coarsely tuberculate. Sterile cells few, spherical, 14–23 µm in diam., hyaline; wall 3–5 µm thick, smooth. Spore germination results in nonseptate basidium bearing a terminal cluster of basidiospores (Mundkur, 1944:51).

For detailed descriptions and illustrations of **Tilletia brachypodii-ramosi** Zogg, and **T. olida** (Riess) Schröter see Vánky 1994b:244, 249, 256 & 264.

Key to the Tilletia species of Brachypodium.

1. Sori in leaves as long striae. Spores reticulate 2
– Sori in seeds, swollen. Spores otherwise sculptured 3
2. Muri 0.5–1(–1.5) µm high, in median view truncate . . . . T. olida
– Muri 1–1.5(–2.5) µm high, in median view pointed . . . . T. brachypodii-ramosi
3. Spores chocolate-brown, 17.5–24(–26) µm long . . . . T. brachypodii-mexicani
– Spores reddish-brown, smaller, 13.5–20 µm long (excluding sheath) 4
4. Spores irregularly, coarsely tuberculate, with a thick sheath . . T. brachypodii
– Spores regularly verrucose, sheath lacking . . . . T. colombiana

The smut fungi of Trachypogon (Gramineae).

Zundel (1933:353) described Spacelotheca trachypogonis on Trachypogon vestitus from Brazil. This fungus shows the characters of a Sporisorium:

Sporisorium trachypogonis (Zundel) K. Vánky, **comb. nov.**
Basionym: Spacelotheca trachypogonis Zundel, Mycologia 25:353, 1933. – Type on Trachypogon vestitus Anderss., Brazil, Matto Grosso, Campo Grande, alt. 540–550 m, 7–11.II.1930, A. Chase (Plants of Brazil No. 10826; BPI 192088!).

Sori in some ovaries of an inflorescence, long linear, 1–2 x 20–30 mm, covered by a delicate greyish membrane which ruptures revealing a dark brown, powdery spore mass and a well formed central columella. Spore balls loose, irregular, composed of many spores. Mature spores single, variable in size, globose or subglobose, rarely broadly ellipsoidal, 7–15 x 7–16 µm, reddish-brown; wall 1.5–4 µm thick (including ornamentation), provided with prominent, acute or subacute, 1–3 µm high spines which often are connected forming irregular, incomplete meshes. Sterile cells single or in irregular groups, globose, ellipsoidal to irregular, with flattened sides, 5.5–12 µm long, hyaline, wall 0.5–2.5 µm thick, smooth.

Zundel (1938:292) described another fungus on Trachypogon plumosus from South Africa as Ustilago trachypogonis. This incompletely described smut also shows the characters of a Sporisorium:

Sporisorium zundelianum K. Vánky, **nom. nov.**
Replaced synonym: Ustilago trachypogonis Zundel, Bothalia 3:292, 1938 (non Sporisorium trachypogonis (Zundel) K. Vánky, opus ipsum). – Sphacelotheca trachypogonis (Zundel) Zambettakis, 1979(1980):415 (nomen illegit., non Sphacelotheca trachypogonis Zundel, 1933). – Type on Trachypogon plumosus (H. & B. ex Willd.) Nees, Union of South Africa, Transvaal, Kaalfontein, 22.II.1918, A. O. D. Mogg (BPI 194480!).

Sori in all ovaries of an inflorescence, protected and partly hidden by the floral envelopes, cylindrical, ca. 0.8 x 3–5 mm, first covered by a thin, greyish membrane which early ruptures disclosing the dark brown, powdery spore mass intermixed with groups of sterile cells surrounding a simple, rarely shortly bifurcate, central columella. Spores when mature single, globose, subglobose to usually ovoid or ellipsoidal, 4–5 x 5–7(–8) µm, olivaceous-brown; wall thin (ca. 0.5 µm), uniform, verrucose, warts just affecting the spore profile. Sterile cells in short chains, rarely in groups or solitary, usually laterally compressed, in face view rounded or slightly irregular, in lateral view elliptic, half circular or with two flattened sides, larger than the spores, (4–)5–9 x 5–10 µm, pale yellowish-brown; wall smooth, thick (2–4 µm), lumen often reduced to a minimum or non-existent.

Some years ago, Durán described:

Tilletia trachypogonis Durán, 1987:162.
Type on Trachypogon secundus (Presl) Scribn., Mexico, 18 km N.W. of Cuautlixo, off Hway. 115, alt. 1524 m, 10.XI.1978, R. Durán & P. M. Gray (WSP 67748; isotype in HUV 14048!).

Sori in scattered ovaries, cylindrical, 1.5 x 9 mm. Spores subglobose to subpolyhedral, 20–30 µm in diameter, chocolate-brown, opaque, verrucose, warts ca. 1.5 µm high. Sterile cells rare, globose, 15–17 µm in diam., light brown; wall laminate, up to 5 µm thick, smooth.

From the same place and host, Durán described a further smut:

Tolyposporella puccinioides Durán, 1987:198.
Type on Trachypogon secundus (Presl) Scribn., Mexico, 18 km N.W. of Cuautlixo, off Hway. 115, alt. 1524 m, 10.XI.1978, R. Durán & P. M. Gray (WSP 67750; isotype in HUV 14052!).

Sori on the adaxial surface of the leaf sheaths, forming a black, dusty, granular-powdery spore mass. Spore balls irregular, 110–190 x 140–300 µm, opaque, permanent, consisting of numerous, firmly agglutinated spores. Spores ovoid, lacrimiform or irregular, 8–13.5 x 11–32 µm in diameter, including the 0.5–8.5 µm thick, sometimes laminated, smooth exospore.

A smut fungus with sori comprising the whole inflorescence, Sphacelotheca macalpineae Zundel, was recorded on several Trachypogon species (Zundel, 1943:170). Langdon (1960:300) demonstrated that S. macalpineae Zundel is a synonym of S. amphilophis H. Sydow. This smut also has the characters of a Sporisorium and was transferred into this genus by Langdon & Fullerton (1978:451). Indeed, a smut fungus on Trachypogon montufari (H., B. & K.) Nees (= T. mollis Nees), from Brazil, Minas Geraes, Pocos de Caldas, alt. 1100-1500 m, 18-20.I.1930, A. Chase (BPI 178061!), and Matto Grosso, Tres Lagoas, alt. 300-325 m, 4-5.II.1930, A. Chase (BPI 178064!) is indistinguishable from the type of "Sphacelotheca" macalpineae Zundel. Not having seen the type of Sporisorium amphilophis, I am treating this smut fungus of Trachypogon, with some hesitation, under the name of:

Sporisorium amphilophis (H. Sydow) Langdon & Fullerton, 1978:451. Sphacelotheca amphilophis H. Sydow, 1935:232. – Type on Amphilophis insculpta (Hochst.) Stapf (= Bothriochloa insculpta (Hochst.) A. Camus), Union of South Africa, Transvaal, Barberton, near Schagen, VI.1931, L. C. C. Liebenberg (no. 26023; PRE).

Sphacelotheca bothriochloae Zundel, 1939:587 (as "botriochloae"). – Type on Bothriochloa decipiens (Hackel) C. E. Hubbard (Amphilophis decipiens (Hackel) Stapf), Australia, New South Wales, Walla, 17.V.1937, R. A. Black (Synonymy according to Zundel, 1953:79).

Sphacelotheca macalpineae Zundel (1939:583). – Type on Andropogon intermedius R. Br. (= Bothriochloa intermedia (R. Br.) A. Camus), Australia, New South Wales, coll. in 1912, as Cintractia columellifera (BPI 178058!). (Synonymy according to Langdon, 1960:300).

Sori comprise the whole inflorescence, long linear, 1–7 cm long, first covered by a thick, yellowish-white to brown peridium which ruptures irregularly revealing a dark brown, semiagglutinated to powdery spore mass intermixed with sterile cells and a well-developed, simple or ramified columella. Spores when mature single, globose, subglobose, ellipsoidal to slightly irregular, 7–9.5(–10.5) x 8–10(–11) µm, light reddish-brown; wall even, thin (ca. 0.6 µm), finely punctate-echinulate. Sterile cells globose, 7–12 µm in diam., hyaline, in irregular groups or chains, collapsed in old specimens.

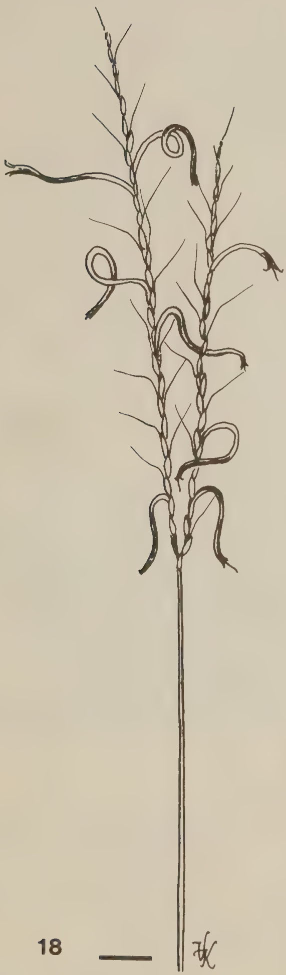
Recently, two distinct smut fungi were collected, which are described here as:

Sporisorium trachypogonis-plumosi K. Vánky, **sp. nov.**

Typus in matrice Trachypogon plumosus (H. & B. ex Willd.) Nees, Venezuela, Distr. Federal, 8 km N.E. oppid. Colonia Tovar, 10°28’ N, 67°14’ W, alt. ca. 1700 m., 16.XII.1993, leg. C. & K. Vánky. Holotypus in Herbario Ustil. Vánky (HUV 16034!); isotypi in VEN, VIA and in Vánky, Ust. exs. no. 927.

Sori (Fig. 18) in ovariis, longe cylindrici, contorti vel spiralisati, 1,5–2 x 25–50 mm, membrana cinerea cooperti; membrana longitudinaliter rupta massam granulosam-pulveream glomerulorum sporarum et sporas cum gregibus irregularibus cellularum sterilium immixtis, deinde columellam longam, centralem flagelliformem ostendens. Pars distalis sori forte jam evacuata, sed pars proximalis adhuc massas sporarum immaturarum agglutinatas continens. Glomeruli sporarum (Fig. 16) laxi, irregulares, polyspori, leviter disintegratae. Sporae (Figg. 16, 17) globosae, subglobosae usque late ellipsoideae, 6–8,5 x 7–10 µm, rufobrunneae; pariete 1–2,5 µm crasso, leniter tuberculato usque dense echinulato (0,5–1,5 µm) sub SEM, magis conspicue in parte libera sporarum peripheralium. Cellulae steriles (Fig. 16) subglobosae, ovoideae usque parum irregulares, 5,5–11 µm longae, tenuiter tunicatae (caa. 0,5 µm), hyalinae, leves, cum 1–2 guttulis oleosis. Germinatio sporarum (agaro aquoso, temp. conclavis solita, 1 dies; Fig. 19) basidia septata leviter disintegrata, basidiosporas 1–1,5 x 3–6,5 µm, laterales et terminales, ellipsoideas producentes efficiens.

Sori (Fig. 18) in ovaries, long cylindrical, contorted or looped, 1.5–2 x 25–50 mm, covered by an ashy-grey membrane which ruptures longitudinally to expose the granular-powdery mass of spore balls and spores intermixed with irregular groups of sterile cells, and a long, central, flagelliform columella. The distal part of the sori may be empty while the proximal part may still contain immature, agglutinated spore masses. Spore balls (Fig. 16) loose, irregular, many-spored, readily disintegrating. Spores (Figs. 16, 17) globose, subglobose to broadly ellipsoidal, 6–8.5 x 7–10 µm, reddish-brown; wall 1–2.5 µm thick, finely tuberculate to coarsely echinulate (0.5–1.5 µm) under SEM, more pronounced on the free surface of the peripheral spores. Sterile cells (Fig. 16) subglobose, ovoid to slightly irregular, 5.5–11 µm long, thin-walled (ca. 0.5 µm), hyaline, smooth, with 1–2 oil droplets. Spore germination (on WA, at room temp., in one day; Fig. 19) results in septate basidia which disintegrate readily producing lateral and terminal, ellipsoidal basidiospores measuring 1–1.5 x 3–6.5 µm.



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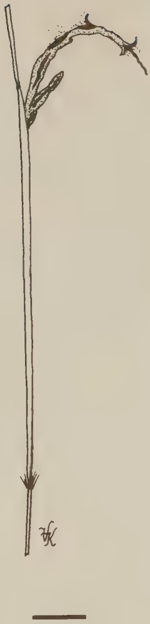

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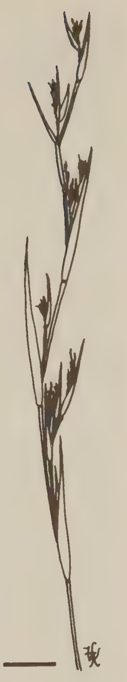

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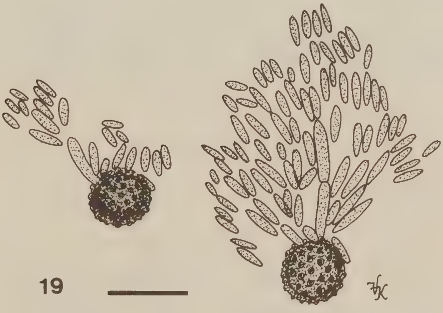

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Fig. 18. Sori of Sporisorium trachypogonis-plumosi in some of the ovaries of Trachypogon plumosus (type). Bar = 1 cm.

Fig. 19. Spore germination of Sporisorium trachypogonis-plumosi (type; on water-agar, at room temp., in one day). Bar = 10 µm.

Fig. 20. A sorus of Sporisorium trachypogonicola in the inflorescence of Trachypogon plumosus (type). Bar = 1 cm.

Fig. 21. Sori of Sporisorium exsertiformum in the racemes of Themeda australis (type). Bar = 1 cm.

Together with the type of Sporisorium trachypogonis-plumosi, a further smut was collected on Trachypogon plumosus, in its sorus structure resembling Sporisorium amphilophis. However, the spores of this smut are more irregular, lighter coloured and more indistinctly ornamented than those of S. amphilophis, and is described here as:

Sporisorium trachypogonicola K. & C. Vánky, **sp. nov.**

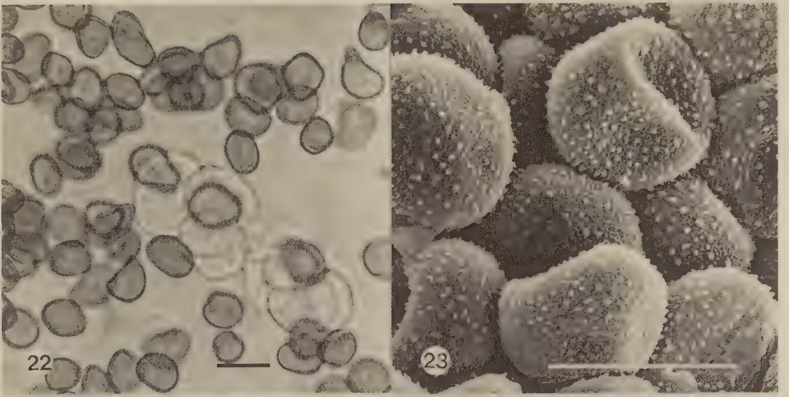
Typus in matrice Trachypogon plumosus (H. & B. ex Willd.) Nees, Venezuela, Distr. Federal, 8 km N.E. oppid. Colonia Tovar, 10°28’ N, 67°14’ W, alt. ca. 1700 m., 16.XII.1993, leg. C. & K. Vánky (Herb. Ustil. Vánky, HUV 16064!).

Sori (Fig. 20) inflorescentiam totam comprehendentes, longe lineares, 2–3 mm x 3–6 cm, primo peridio crasso, flavobrunneo cooperti, deinde eodem irregulariter rupto, massam sporarum atrobrunneam, semiagglutinatam usque pulveream, cum gregibus cellularum sterilium et columella bene evoluta, centrali, simplici intermixtam ostendentes. Sporae maturae (Figg. 22, 23) singulares, ovoideae usque elongatae, irregulares, pyriformes, vel interdum polis subacutis instructae, 6–8,5 x 6,5–10(–11) µm, pallide flavobrunneae; pariete aequali, tenui (cca. 0,5 µm), conspicue levi usque leviter, mediocriter dense punctato. Cellulae steriles (Fig. 22) forma magnitudineque variabiles, globosae, ellipsoidales vel irregulares, lateribus deplanatis, 7–16 µm longae, in greges parvos vel in catenas breves compositae, hyalinae, pariete levi, cca. 1 µm crasso.

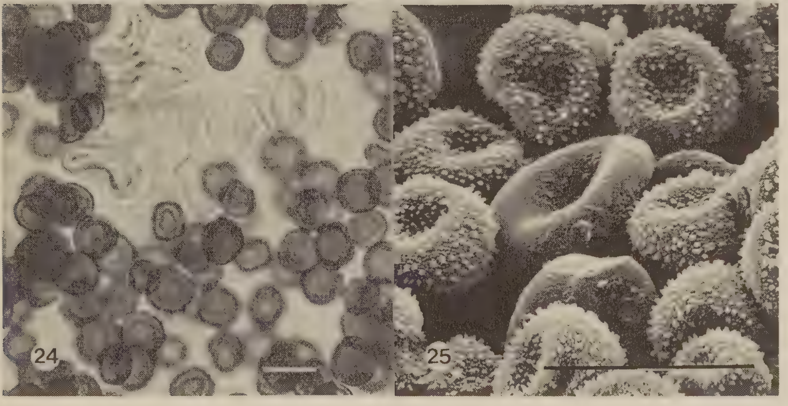
Sori (Fig. 20) comprise the whole inflorescence, long linear, 2–3 mm x 3–6 cm, first covered by a thick, yellowish-brown peridium which ruptures irregularly revealing a dark brown, semiagglutinated to powdery spore mass intermixed with groups of sterile cells and a well-developed, simple, central columella. Spores (Figs. 22, 23) when mature single, ovoid to elongated, irregular, pyriform, or sometimes with subacute tips, 6–8.5 x 6.5–10(–11) µm, light yellowish-brown; wall even, thin (ca. 0.5 µm), apparently smooth to finely, moderately densely punctate. Sterile (Fig. 22) cells variable in shape and size, globose, ellipsoidal or irregular, with flattened sides, 7–16 µm long, in irregular small groups or short chains, hyaline, with ca. 1 µm thick, smooth wall.

Key to the Trachypogon smuts.

1. Sori on the adaxial surface of the leaves .... Tolyposporella puccinioides
– Sori elsewhere 2
2. Sori in the whole inflorescence 3
– Sori in the ovaries 4
3. Spores irregular, smooth to finely punctate .... Sporisorium trachypogonicola
– Spores regular, punctate-echinulate .... Sporisorium amphilophis
4. Spores 20–30 µm long .... Tilletia trachypogonis
– Spores smaller 5
5. Sori in all ovaries. Spores 5–8 µm long, verrucose .. Sporisorium zundelianum
– Sori in some ovaries of an inflorescence. Spores larger, echinulate 6
6. Spores 7–16 µm long, with 1–3 µm high spines, often
connected in irregular, incomplete meshes ...... Sporisorium trachypogonis
– Spores 7–10 µm long, with 0.5–1.5 µm high,
isolated tubercles or spines .... Sporisorium trachypogonis-plumosi



Figs. 22, 23. Spores and sterile cells of *Sporisorium trachypogonicola* in LM and in SEM (type). Bars = 10 µm.



Figs. 24, 25. Spores and sterile cells of *Sporisorium exsertiformum* in LM and in SEM (type). Bars = 10 µm.

An additional smut fungus on *Themeda* (Gramineae).

Vánky (1994a:153-165) studied the smut fungi of *Themeda* recognizing 16 species and a further, undescribed one, for which the following description is given:

Sporisorium exsertiformum K. Vánky, **sp. nov.**

Typus in matrice *Themeda australis* (R. Br.) Stapf, Australia, Queensland, Brisbane, Toowong distr., IV.1911, leg. E. Jarvis (BRIP 7866!, ex BRIU 745); isotypus in BRIP (7881!, ex BRIU 2516).

Sori (Fig. 21) racemos occupantes, irregulariter cylindrici, usque 10 mm longi, 0,5–2 mm crassi, primo membrana crassa, flavidobrunnea, fungali cooperti, deinde membrana irregulariter rupta, massam sporarum atrobrunneam, semiagglutinatam usque pulveream cum cellulis sterilibus intermixtam atque columellam centralem origine matricalem ostendentes. Columella simplex vel ramis 1–2 appressis, parvis, 5–12 mm longa, plerumque parum curvata, versus apicem tenuiescens. Sporae (Figg. 24, 25) in globulis laxis, multisporis, mature singulae, globosae, subglobosae usque late ellipsoideae vel subirregulares, 6–8,5 x 6,5–9,5 µm, atro-rufobrunneae; pariete pro ratione valde crasso (1,5–2,5 µm), leniter, modice dense punctato-verrucoso. Cellulae steriles (Figg. 24, 25) subglobosae usque ovoideae, plerumque collapsae, 10–22 µm longae, singulae, in gregibus parvis vel in catenis brevibus; pariete subhyalino, 1,5–2,5 µm crasso, levi.

Sori (Fig. 21) comprising the racemes, irregularly cylindrical, up to 10 mm long, 0.5–2 mm wide, first covered by a thick, yellowish-brown, fungal membrane which ruptures irregularly exposing the dark brown, semiagglutinated to powdery mass of spores intermixed with sterile cells, and a central columella of host origin. Columella simple or with 1–2 short, appressed branches, 5–12 mm long, usually slightly curved, tapering toward its apex. Spores (Figs. 24, 25) in loose, many-spored balls, when mature single, globose, subglobose to broadly ellipsoidal or slightly irregular, 6–8.5 x 6.5–9.5 µm, dark reddish-brown; wall relatively very thick (1.5–2.5 µm), finely, moderate densely punctate-verrucose. Sterile (Figs. 24, 25) cells subglobose to ovoid, usually collapsed, 10–22 µm long, single, in small groups or short chains; wall subhyaline, 1.5–2.5 µm thick, smooth.

Sporisorium exsertiformum resembles *S. exsertum* in sorus characters and spore measurements but they differ in the thickness of the spore wall which is 1.5–2.5 µm in *S. exsertiformum* and 1–1.5 µm in *S. exsertum*.

Two additional smuts belonging to *Endosporisorium*.

Vánky (1995:226) described the genus *Endosporisorium* characterized by sori in the interior of the culms of Gramineae transforming them into tubes filled by a dark, powdery mass of loose spore balls intermixed with irregular groups of sterile cells. Fungal peridium and columella lacking. Two species were transferred into this genus: *Endosporisorium capillipedii* (J. N. Mishra) K. Vánky (on *Capillipedium* and *Chrysopogon*), and *E. loudetiae* (Viennot-Bourgin) K. Vánky (on *Loudetia*). A further two species also show the characters of *Endosporisorium*:

Endosporisorium effusum (H. & P. Sydow) K. Vánky, **comb. nov.**

Basionym: *Ustilago effusa* H. & P. Sydow, in H. & P. Sydow & Butler, Ann. Mycol. 4:425, 1906. – Type on *Andropogon muricatus* Retz. (= *Vetiveria zizanioides* (L.) Nash), India, Assam, Sylhet distr., Kanaighat, 21.V.1905, E. J. Butler (450; HCIO 450!).

Sori in the interior of yellowish-white culms which split longitudinally disclosing the dark brown, semi-powdery mass of loose spore balls intermixed with a few groups of sterile cells. Spore balls many-spored, subglobose, elongated or irregular, 20–60(–80) x 20–80(–120) µm or occassionally larger, readily disintegrating into groups or single spores. Spores globose, subglobose to broadly ellipsoidal, 3.5–5.5 x 4–6(–6.5) µm, reddish-brown; wall thin, verrucose. Sterile cells few, in groups or single, globose to ovoid, larger than the spores (5.5–8 µm long), collapsed in old specimens.

Known from India (Assam) on *Vetiveria zizanioides* (L.) Nash, *Chrysopogon aciculatus* (Retz.) Trin. (tribe *Andropogoneae*), and on *Arundinella bengalensis* (Spreng.) Druce (*A. wallichii* Trin.; tribe Arundinelleae).

Endosporisorium effusum differs from the other *Endosporisorium* species especially by the small size of its spores.

Sydow (in Sydow & Petrak, 1928:431) described *Sorosporium pachycarpum* H. Sydow as having sori in "foliis terete-involutis". *Ling (1949:134)* wrote: "The agglutinated sori and their occurence in the leaves provide the ground for transferring this species from *Sorosporium* to *Tolyposporella*." Examination of rich material on *Rottboellia ophiuroides* Benth. from New Guinea, Morobe, 19.XI.1939, M. S. Clemens (HUV 16772), obtained in exchange from the late Prof. C. Zambettakis (PC), showed that the sori actually develop in the interior of the stems which early dehisce longitudinally. This observation is also supported by the fact that on the top of a few sori aborted flowers could be seen. The given, extremely thick spore wall measurements (3–5 µm) represent the distance from the spore edge to the large, globose content (nucleus?); the spore wall is much thinner (demonstrated also on ruptured spores).

Endosporisorium pachycarpum (H. Sydow) K. Vánky, **comb. nov.**
Basionym: *Sorosporium pachycarpum* H. Sydow, in Sydow & Petrak, Ann. Mycol. 26:431, 1928. – *Tolyposporella pachycarpa* (H. Sydow) L. Ling, 1949:133. – Type on *Rottboellia ophiuroides* Benth., Philippine Islands, Luzon (sel. Ling, 1949:133), Pampanga Prov., Stotsenberg, XI.1923, M. S. Clemens (BPI).

Sori in the interior of the stems, tubular, pale coloured, early rupturing longitudinally exposing the black, semiagglutinated to granular powdery mass of spore balls. No peridium of fungal tissue, no columella. The sori appear as 5–25 cm long, twisted and spirally bent, whip-like bands of host tissue permeated by hyphae, with black spore balls still adhering on the original inner surface. Usually all shoots of a plant are affected. Spore balls apparently loose but rather permanent, globose, ovoid, elongate or irregular, 30–80 x 50–110(–150) µm, yellowish- or dark olivaceous-brown to opaque, composed of (5–)10–60 or more spores. Spores globose, ovoid, ellipsoidal or irregular with one or several flattened sides, 14–23 x 15–25(–28) µm, yellowish-brown, light reddish-brown to blackish-brown. Each spore with a large, globose or ovoid, hyaline, finely granular content (nucleus?). Spore wall 1.5–2.5 µm thick (including ornamentation), provided with 1–1.5 µm high, irregular, coarse prismatic warts, sometimes arranged in short rows or groups. Sterile cells absent.

Endosporisorium pachycarpum differs from the other three *Endosporisorium* species, not only in having large spores agglutinated in rather permanent, dark spore balls, but also by the absence of sterile cells between the spore balls. In this respect there is a parallelism between *Endosporisorium* and *Sporisorium*, namely, in *Sporisorium* species with dark and permanent spore balls the sterile cells are usually also lacking.

Key to *Endosporisorium* species.

1. Spores 4–6.5 µm long, verrucose	*E. effusum*
– Spores larger	2
2. Spores 8–11 µm long	3
– Spores 15–28 µm long, coarsely verrucose	*E. pachycarpum*
3. Spores echinulate	*E. capillipedii*
– Spores apparently smooth to finely punctate	*E. loudetiae*

The smut fungi of *Eriochloa* (Gramineae).

Three smut fungi have been described from different *Eriochloa* species: 1. *Tilletia mixta* Massee, 2. *Sorosporium eriochloae* Griffiths, and 3. *Ustilago eriochloae* Ling. The first one is a *Sporisorium* (*S. mixtum*). The second species is identical with and synonymous to *Sporisorium mixtum*. The third species is actually *Ustilago schroeteriana* P. Henn. on *Paspalum* (M. Piepenbring, pers. comm.). Consequently, only one smut fungus is presently known on *Eriochloa*:

Sporisorium mixtum (Massee) K. Vánky, **comb. nov.**
Basionym: Tilletia mixta Massee, Bull. Misc. Inform. 1899:145. – Sorosporium mixtum (Massee) McAlpine, 1910:178. – New lectotype (selected here*) on Eriochloa annulata (Fluegge) Kunth (= E. procera (Retz.) C. E. Hubb.), Australia, N. S. W., Murrumbidgee, Bennett (NY!).

Sorosporium eriochloae Griffiths, 1904:84. – Type on Eriochloa punctata (L.) Desv., USA, Arizona, Santa Rita Mountains, Empire Ranch, 28.IX.1902, Griffiths & Thornber (BPI 195112!).

Sori in the flowers comprising the ovaries and often also the lemma and palea, oblong, 1–1.5 x 2–5 mm, partly concealed by the glumes, covered by a whitish to pale brown peridium composed of several, tightly packed layers of elongated, rectangular, fungal cells. The peridium ruptures irregularly, usually from its apex, exposing the black, granular-powdery mass of spore balls and a 2–5 mm long central columella with short branches on its distal part. Spore balls subglobose, ellipsoidal to elongated or irregular, 30–55 x 35–80(–100) µm, reddish-brown, composed of numerous, readily separating spores. Spores subglobose, ellipsoidal to subpolyhedrally irregular, 8–13 x 9.5–15 µm, reddish-brown; wall uniform, ca. 0.8 µm thick, densely, evidently verruculose-echinulate. Sterile cells between the spore balls were not observed.

*Massee (1899:145) indicated two syntypes for his T. mixta: the lectotype selected above, and "Festuca microstachya Desv., U.S.A., Idaho, Boise City, Ellis & Everhart", referring to Ellis & Ev., N. Amer. fgi. no. 1895, sub Tilletia fusca. However, this exsiccata represents another fungus, Ustilago mulfordiana Ellis & Everhart, 1895:362 (HUV 4153!). Zundel (1953:67), based on McAlpine (1910:179), who wrote that "This smut was originally found in Arizona on Eriochloa punctata . . . . collected by Bennett in 1886", selected this latter specimen as type of Sorosporium mixtum. This specimen is not mentioned in the protologue, hence the new selection above.

Ling (1951:103) described Ustilago eriochloae on "Eriochloa punctata (L.) Desv.", from Costa Rica, Turrialba, 29.IX.1947, F. L. Wellman (BPI 160383!). Miss Meike Piepenbring, during the preparation of her doctoral thesis about the Ustilaginales of Costa Rica, checked the type specimen of U. eriochloae. She found, apart from a healthy plant of Eriochloa punctata, Ustilago schroeteriana on Paspalum cf. paniculatum L., demonstrating that Ustilago eriochloae Ling is a synonym of U. schroeteriana P. Henn.

SYNONYMY

Tolyposporium juncophilum is a synonym of Urocystis junci.

McAlpine (1910:188) when describing Tolyposporium juncophilum overlooked the presence of relatively dark, usually collapsed sterile cells around the large, opaque spore balls. Vánky (1985:4-5) bleached the spore balls, revealing the presence of sterile cells around the spores, and demonstrated that this fungus is actually a Urocystis. Recent studies showed that it is identical with and synonymous to:

Urocystis junci Lagerheim, 1888:201.
Lectotype on Juncus filiformis L., (selected by Lindeberg, 1959:89) Switzerland, Graubünden Kt., Ober-Engadin, at the Berninabach near Pontresina, VIII.1888, G. Lagerheim; isolectotypes in Roumeg., Fgi. sel. gall. exs. 4870 (HUV 2803!).

Tolyposporium juncophilum McAlpine, 1910:188. Lectotype on Juncus pallidus R. Br., Australia, (sel. by Zundel, 1953:130) New South Wales, XI.1901, Helms.

Sori in interior of the culms which are often spirally twisted, up to 15 cm long. The culms rupture longitudinally exposing the blackish-brown, granular powdery mass of spore balls. Spore balls variable in shape and size, globose to irregular, 20–44 x 22–56(–64) µm in diameter, composed of 1–20(–more) spores completely invested by sterile cells. Spores subglobose, ovoid or slightly irregular, 9.5–13 x 11–16(–19) µm, reddish-brown, smooth. Sterile cells variable in shape and size, 5.5–14.5(–16) µm long, light reddish-brown, smooth, collapsed when dried.

The ratio of spores per spore ball for the type of Urocystis junci is: 1-spored balls =3%, 2=6%, 3=7%, 4=11%, 5=14%, 6=10%, 7=9.5%, 8=8%, 9=6.5%, 10=6%, 11=4%, 12=1.5%, 13=2%, 14=3%, 15=2%, 16=0.5%, 17=0.5%, 18=1.5%, 19=1%, 20=1.5%, 21=0.5%, 22=0.5%, 23=0.5%. These values are similar also for "Tolyposporium" juncophilum.

EXCLUDED SPECIES

Sphacelotheca dinebrae is an Ustilaginoidea species.

Mundkur (1939:109) described Sphacelotheca dinebrae Mundkur, with type on Dinebra retroflexa (Vahl) Panzer (Gramineae, Tribe Eragrostideae), India, Bengal, Banarhat, 24.VIII.1908, I. H. Burkill (HCIO 7299!). Study of the sori and spores of the type specimen revealed that this fungus is an Ustilaginoidea, a Hyphomycete, parasitizing ovaries of Gramineae in warmer regions.

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USTILAGINALES OF SCHOENUS (CYPERACEAE).*

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ABSTRACT

The smut fungi of the ca. 100 species of Schoenus were revised. Nine species and a hybrid are known to be infected. On these, six smut fungi could be recognised (of which two are new): Anthracoidea andina (Kukkonen) K. Vánky, comb. nov. (type on Sch. andinus), Anthracoidea schoenus (G. H. Cunn.) K. Vánky (type on Sch. pauciflorus), Sorosporium solidum (Berk.) McAlpine (type on Sch. imberbis), Tolyposporium kochianum Gäumann (type on Sch. nigricans x ferrugineus), Tolyposporium laevigatum K. Websdane & K. Vánky, sp. nov. (type on Sch. laevigatus), and Tolyposporium schoeni K. Vánky & E. McKenzie, sp. nov. (type on Sch. brevifolius). Descriptions and illustrations of these species are given and a key to these species is compiled. The generic position of Sorosporium solidum is considered to be uncertain.

INTRODUCTION

Similar to the Ustilaginales of so many other host genera, the smut fungi of Schoenus (fam. Cyperaceae, subfam. Cyperoideae, tribus Rhynchosporeae) are unsatisfactorily known. According to Moore & Edgar (1970:191), there are about 100 species of Schoenus or, according to Engler's book (1964:604), ca. 85 species, occuring mostly in Australia, New Zealand and New Guinea. The sole cosmopolitan species is S. nigricans L., whereas S. ferrugineus L. occurs only in Europe. On these 100 species of Schoenus only four smut fungi were reported. Altogether 8 host species and a hybrid were found infected.

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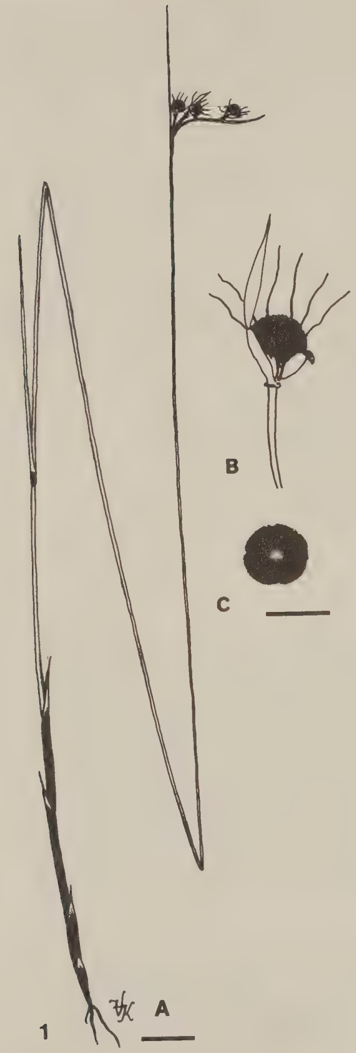
* Part 115 in the series "Studies in Heterobasidiomycetes" from the Botanical Insitute, University of Tübingen.



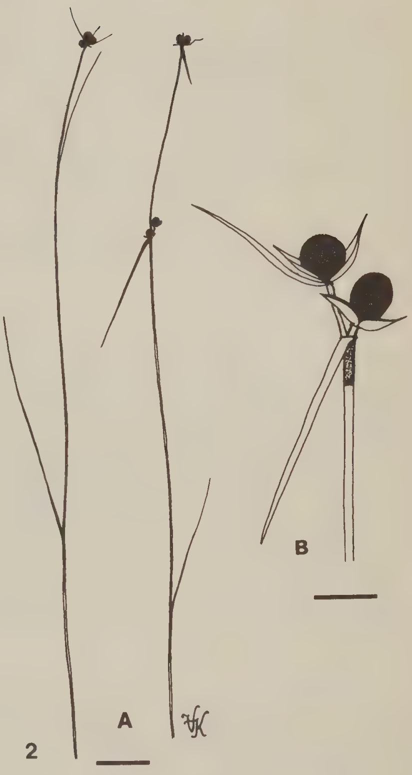


Fig. 1. Anthracoidea schoenus on Schoenus pauciflorus. A. Habit. B. Enlarged sorus. C. Transversal section of a sorus showing the black, agglutinated spore masses around the nut (Vánky, Ust. 457). Bars = 1 cm and 3 mm respectively.

Fig. 2. Sorosporium solidum on Schoenus apogon. A. Habit. B. Enlarged inflorescence with two sori (Vánky, Ust. 753). Bars = 1 cm and 2 mm respectively.

The first smut on a Schoenus was described by Berkeley (in Hooker, 1860) on Chaetospora imberbis R. Br. (= Schoenus apogon Roem. & Schult.) from Tasmania, as Ustilago solida. Because the spores of this fungus are agglutinated in spore balls, McAlpine (1910) transferred it into the genus Sorosporium. Cunningham (1928) reported the next smut, Cintractia schoenus, on Schoenus pauciflorus, from New Zealand. Showing the characters of an Anthracoidea, the name of this fungus was transferred by Vánky (1979) into this genus. Gäumann (1932) described Tolyposporium kochianum on Schoenus nigricans x ferrugineus, from Switzerland, the sole known smut on this host genus in Europe (comp. Vánky, 1994). Finally, Kukkonen (in Roivainen, 1977) described Cintractia andina on Schoenus andinus, from South America (Tierra del Fuego).

The authors of this paper collected several smutted Schoenus in New Zealand and Australia. On these, two further undescribed smut fungi were found.

MATERIALS AND METHODS

For microscopical studies dried specimens were used. If possible type specimens were studied (marked with "!"). Light microscope (LM) with an oil immersion lens, at a magnification of 1100 x was used for studies of spore morphology and measurements. For this purpose dried spores were rehydrated in lactophenol by gentle heating to the boiling point. Black spore balls were bleached in concentrated hydrogen peroxide (H_2O_2) for 5–60 minutes, permitting examination of the spore balls structure, the shape of the spores and counting of the spores in the balls. Because the treatment of the spores with hydrogen peroxide swells up the walls, no measurements were done on such bleached spores. Germinated spores, as well as spore ball formations, were studied in lactophenol with cotton blue (lactic blue). For studies of the sorus structure and spore ball formations, 0.5 µm thick sections of young sori embedded in plastic were prepared by the standard technique for TEM preparations, and stained with fuchsin – christal violet. For scanning electronmicroscopical (SEM) studies, dried spores were dusted on small pieces of double-sided adhesive tape and sputter-coated with gold-palladium, ca. 20 nm. Germination experiments were carried out in Petri-dishes, on water-agar, at room temperature.

RESULTS AND DISCUSSION

As a result of our investigations, six smut fungi could be recognised on different Schoenus species:

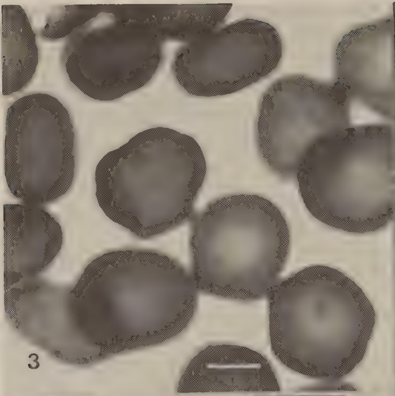
Anthracoidea andina (Kukkonen) K. Vánky, **comb. nov.**

Basionym: Cintractia andina Kukkonen, in Roivainen, Karstenia 17:5, 1977. – Type on Schoenus andinus (Phil.) Pfeiffer, South America, Tierra del Fuego, Lago Escondido, Cerro Garibaldi E., alt 390 m, 3.XII.1969, H. Roivainen (721b; H!).

Sori in the gynoecia, like those of A. schoenus (comp. Kukkonen, in Roivainen, 1977:5), black. Spores (Figs. 3, 4) flattened (11–15.5 µm wide), in plane view subcircular, elliptic, to irregularly subangular with rounded angles, 13.5–21 x 15–24 µm, reddish-brown; wall even to slightly unevenly thickened, 1–2(–2.5) µm; light-refractive spots and internal swellings absent; surface finely and densely punctate-verruculose; spore profile smooth to finely wavy. Germination unknown.

On Schoenus andinus (Phil.) Pfeiffer. Known from only the type locality.

The paucity of the type specimen, seen by the senior author, did not permit to investigate and describe the sorus structure, which is missing in the protologue of this species.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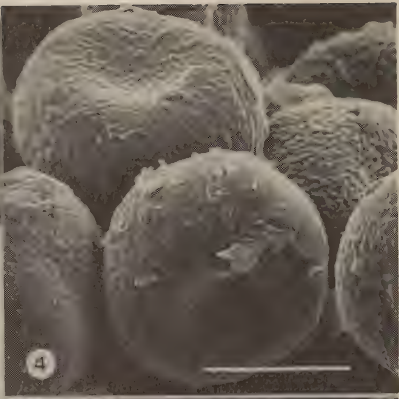
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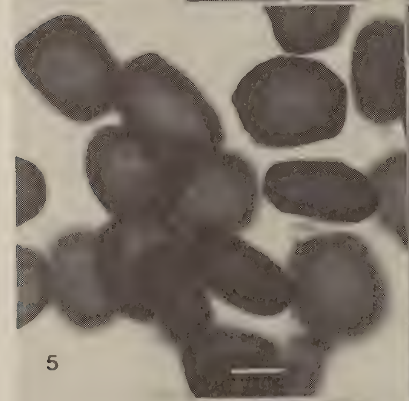
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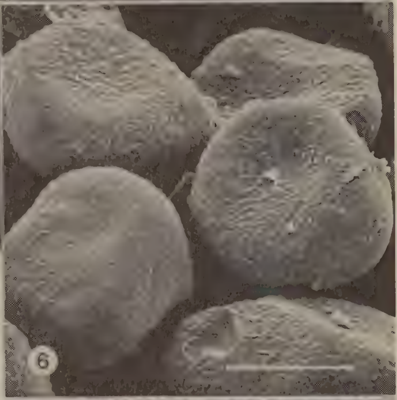
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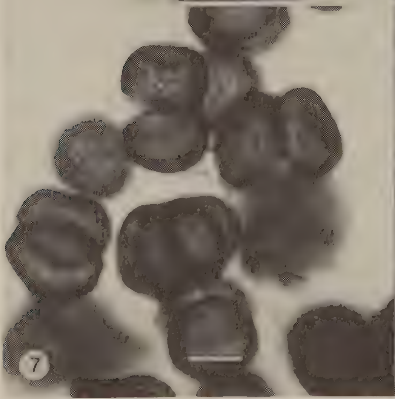
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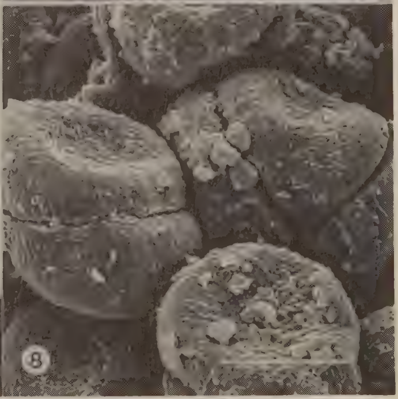
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Anthracoidea schoenus (G. H. Cunn.) K. Vánky, 1979:230.

Cintractia schoenus G. H. Cunningham, 1928:503. – Type on Schoenus pauciflorus Hook. f., New Zealand, Canterbury, Cook Range, alt. 700 m, I.1928, G. H. Cunningham (PDD 3365!).

Sori (Fig. 1) in ovaries, scattered in the inflorescence, as globose to ovoid, hard, black bodies, 1.5–3 mm in diameter, composed of nuts surrounded by the spore mass, originally covered by a thin, silvery, fungal membrane, later black, powdery on the surface. Spores (Figs. 5, 6) flattened (9.5–14 µm wide), in plane view subangularly irregular, rarely subcircular or elliptic, often with conspicuous protuberances, 13–20(–22) x 16–24(–28) µm, light to dark reddish-brown; wall of uneven thickness, 1–4 µm, thickest at the angles and in the protuberances, often with light-refractive spots in the thickest area, rarely 1–3 week internal swellings may be present; surface very finely and densely punctate-verruculose. Germination unknown.

On Schoenus antarcticus (Hook. f.) Dusén (Chile), and S. pauciflorus Hook. f. (New Zealand).

Sorosporium solidum (Berk.) McAlpine, 1910:183.

Ustilago solida Berkeley, in Hooker, 1860:270. – Urocystis solida (Berk.) Fischer von Waldheim, 1877:38. – Type on "Chaetophora" (sphalm. pro Chaetospora) imberbis R. Br. (= Schoenus apogon Roem. & Schult.), Tasmania, Penquite, XII.1845, R. C. Gunn.

Sori (Fig. 2) in ovaries as globose to ovoid, compact, brownish-black bodies, powdery on the surface, 1–1.5 mm in diameter. Spores (Figs. 7, 8) single, in pairs or in loose but rather permanent, usually irregular or globoid to ellipsoidal spore balls developed from a sporogenous hyphal layer. Spore balls composed of 2–15 spores, 20–40 x 25–55(–70) µm in diameter, yellowish- to light reddish-brown. Spores subglobose, usually ovoid or elongated, irregular, flattened on one or two sides, 12–16 x 15–20 µm, yellowish- to light reddish-brown; wall unevenly thickened, 0.5–1.5 µm wide, smooth to rough. Spore germination unknown.

On Schoenus apogon Roem. & Schult. (Australia, New Zealand, Tasmania), S. carsei Cheesem. (New Zealand), S. imberbis R. Br. (Australia, Tasmania), S. maschalinus Roem. & Schult. (New Zealand), and S. pauciflorus Hook. f. (New Zealand).

The generic placement of this species is uncertain and more studies are needed to elucidate this problem. In the original description Berkeley (in Hooker, 1860:270) wrote: "Spores aggregate, subglobose, ... This species connects Ustilago and Sporisorium."

Figs. 3, 4. Spores of Anthracoidea andina on Schoenus andinus in LM and in SEM (Type). Bars = 10 µm.

Figs. 5, 6. Spores of Anthracoidea schoenus on Schoenus pauciflorus in LM and in SEM (Type). Bars = 10 µm.

Figs. 7, 8. Spore balls and spores of Sorosporium solidum on Schoenus apogon in LM and in SEM (Vánky, Ust. 753). Bars = 10 µm.

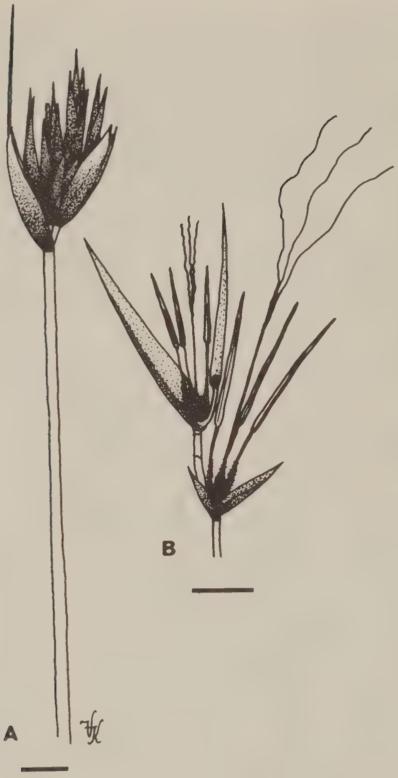

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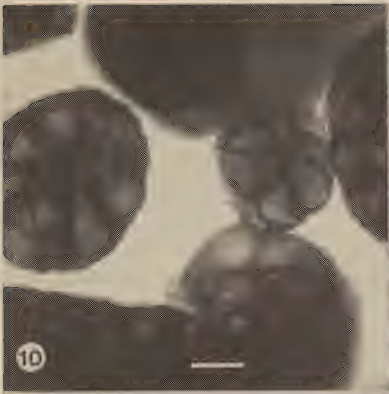
Fig. 9. Tolyposporium kochianum on Schoenus nigricans x ferrugineus (topotype; Vánky, Ust. 189). A. Habit. B. Enlarged a spikelet with three infected flowers. Glumes of the two lower flowers partly removed revealing the black, agglutinated mass of spore balls around the basal part of the filaments and in the nuts. Bars = 3 mm and 1 mm respectively.

Figs. 10, 11. Spore balls of Tolyposporium kochianum on Schoenus nigricans x ferrugineus (topotype; Vánky, Ust. 189) in LM and in SEM. Bars = 10 µm.

Figs. 12, 13, 14, 15. Spore balls and spore ball formation of Tolyposporium laevigatum on Schoenus laevigatus (type) in LM and in SEM. Spores in figs. 14 and 15 are bleached with conc. hydrogen peroxid for 5 minutes and stained with cotton blue. Bars = 10 µm.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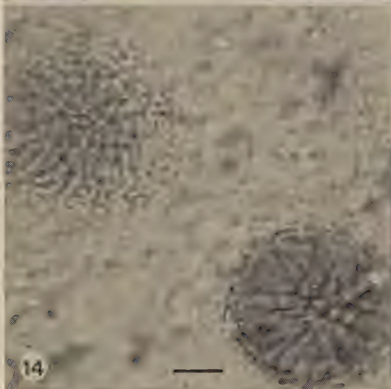
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Tolyposporium kochianum Gäumann, 1932:179.

Type on Schoenus nigricans L. x ferrugineus L., Switzerland, Zürich Kt., at Greifensee Lake, VI.1932, W. Koch & L. Zobrist (ZT!). Topotype: 22.VI.1975, U. Peters, T. & K. Vánky (HUV 2438!); isotopotypes in Vánky, Ust. 189 (HUV 5365!).

Sori (Fig. 9) in flowers, concealed by the bracts, forming initially agglutinated, later granular-powdery, black spore masses around the filaments and in the aborted nuts. Layer of sporogenous hyphal bed absent. Spore balls (Figs. 10, 11) globose, broadly ellipsoidal to irregular, 35–53(–80) µm in diameter, persistent, composed of (2–)10–50(–more) firmly united spores, from reddish- to blackish-brown, opaque. Spores variable in shape and size, in surface view rounded, elliptic, elongate or subpolyangularly irregular, 5.5–11(–12) x 6.5–18 µm, in median view rounded, subcuneiform, elongated or irregular, 8–20 µm long, medium to dark reddish-brown; wall of the free surface 1–3 µm thick, minutely, irregularly verruculose, on the contact sides thinner (0.5–1 µm), smooth.

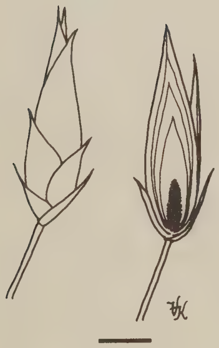
On Schoenus nigricans L. (Italy, Switzerland), and S. nigricans L. x ferrugineus L. (Switzerland).

Tolyposporium laevigatum K. Websdane & K. Vánky, **sp. nov.**

Typus in matrice Schoenus laevigatus W. Fitzg. (det. K. L. Wilson, NSW), Australia, Western Australia, Fitzgerald River National Park, 6.4 km. along road to Quaalup homestead, 34°15' S, 119°23'23" E, alt. ca. 30 m, 6.III.1993, leg. K. Websdane. Holotypus in Herbario Ustil. Vánky (HUV 16730!), isotypus in UWA.

Sori (Fig. 16) in floribus, per partes involucrales florum perfecte cooperti. Massa glomerulorum sporarum nigra, primo agglutinata deinde granuloso-pulverea, superficiem organorum internorum, floralium abortivorum partim obtegens. Glomeruli sporarum (Figs. 12, 13, 14, 15) globosi, subglobosi, ovoidei vel ellipsoidei, 45–60 x 50–85 µm, atro-brunnei, opaci, e multitudine (40–100 vel pluries) sporarum arcte cohaerentium compositi. Sporae (Figs. 13, 15) visu mediano subcuneiformes, elongatae vel irregulares, 12–25 µm longae, visu superficiali superficies libera earum irregulariter polygonalis, (3–)5–11 x (5–)8–13,5 µm, atro-rubrobrunnea usque nigrobrunnea; paries ad superficiem liberam parum convexus, crassus, (2,5–5 µm), verrucis humilibus, irregularibus, saepe confluentibus instructus. Paries laterum conjunctorum tenuis (cca. 0,5 µm), levis. Germinatio ignota.

Sori (Fig. 16) in the flowers, completely hidden by the floral envelopes. The black, first agglutinated, later granular-powdery mass of spore balls is covering in one piece the surface of the inner, aborted floral organs. Spore balls (Figs. 12, 13, 14, 15) globose, subglobose, ovoid or ellipsoidal, 45–60 x 50–85 µm, blackish-brown, opaque, composed of many (40–100 or more), firmly united spores. Spores (Figs. 13, 15) in median view subcuneiform, elongated or irregular, 12–25 µm long, in surface view, the free surface of the spores is irregularly polygonal, (3–)5–11 x (5–)8–13.5 µm, dark reddish- to blackish-brown; wall of the free surface is slightly convex, thick (2.5–5 µm), provided with irregular, often confluent, low warts. Wall of contact sides thin (ca. 0.5 µm), smooth. Germination unknown.



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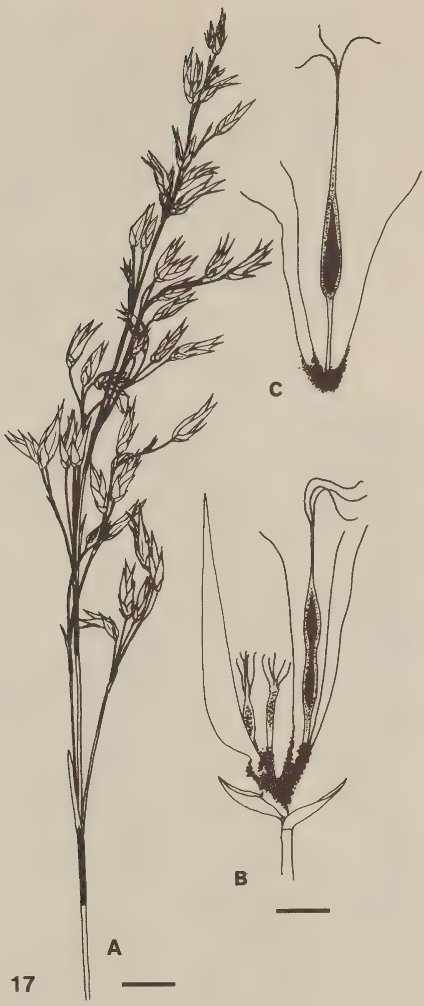

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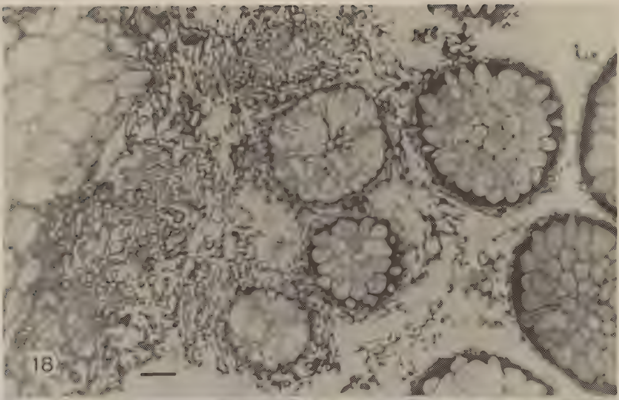
Fig. 16. Tolyposporium laevigatum on Schoenus laevigatus (type). Enlarged two infected spikelets, one of them longitudinally sectioned showing the agglutinated mass of spore balls around the inner floral organs. Bar = 2 mm.

Fig. 17. Tolyposporium schoeni on Schoenus brevifolius (type). A. Habit. B. Enlarged a spikelet with most glumes removed, showing three infected and deformed flowers. C. Enlarged a flower without glumes, with agglutinated mass of spore balls around the basal part of the filaments of aborted stamens, and in the aborted and deformed nut which split longitudinally. Bars = 1 cm and 1 mm respectively.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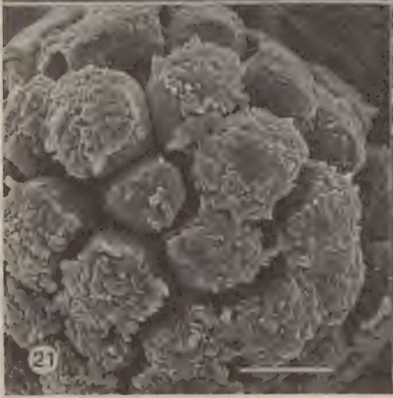
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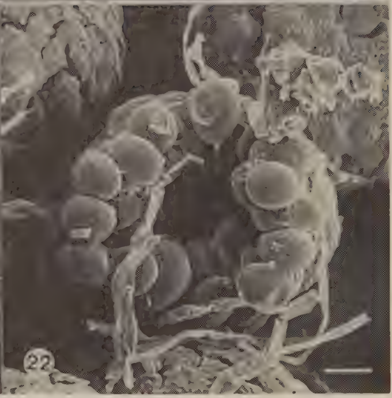
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Transversal section of a sorus (Fig. 18) shows host tissues completely surrounded by mycelia in which the spore balls are differenciating and maturing centrifugally. Inter- and intracellular hyphae are present in the host tissues. The epidermis of the host plant is interrupted in some places where the sporogenous part of the fungus on the surface of the host plant is connected with the parasitic part of the fungus from the host tissues. Close to the external surface of the host epidermis, sporogenous hyphae are concentrating in small groups. In the middle of these groups, very young spore initials appear as fungal cells with increased diameter. In the course of time, the spore initials become larger but are still more or less isodiametrical, and the young spore balls are surrounded by a thick layer of undifferentiated mycelia. By maturation, the young spores become elongated, laterally flattened, reach the size and the form of the mature spores, become pigmented and the balls are pushed toward the periphery of the sori. The spore walls at the surface of the balls become thick and ornamented, and the undifferentiated layer around the balls becomes thin. The remnants of this layer on the surface of the spore balls may hide the ornamentation of the spores and the limit between them when seen in SEM.

Tolyposporium schoeni K. Vánky & E. McKenzie, **sp. nov.**

Typus in matrice Schoenus brevifolius R. Br., New Zealand, North Island, Northland, Karikari Peninsula, Inland Road, old gumdiggers site. 34°58' S, 173°23' E, alt. ca. 15 m, 9.II.1990, leg. E. H. C. McKenzie, P. R. Johnston & K. Vánky. Holotypus in Herbario Ustil. Vánky (HUV 16501!); isotypi in PDD 63729, BPI and in Vánky, Ustil. exs. (inedited). Paratypi: New Zealand, North Island, Auckland, New Lynn, 30.I.1922, H. Carse (HUV 16727! & CHR 293572); Auckland, Hobson Co., Lake Taharoa, 24.XII.1971, A. E. Esler (HUV 16726! & PDD 56451).

Sori (Fig. 17) in floribus, per partes involucrales perfecte obtecti. Massa glomerulorum sporarum nigra, primo agglutinata, deinde granuloso-pulverea, superficiem partis proximalis filamentorum obtegens atque simul nuces abortivos deformatosque cito longitudinaliter discissos implens. Stratum hypharum sporogenearum ut videtur nullum. Glomeruli sporarum (Figg. 19, 20, 21, 22) forma magnitudineque variabiles, ovoidei, elongati vel irregulares, 50–90 x 60–120(–150) μm, atro-rubrobrunnei usque fuscobrunnei, opaci, e multitudine (80 usque pluries centum) sporarum arcte unitarum compositi. Pars interior glomerulorum sporarum magnorum vacua, vel haec caverna centralis forte sporis laxe dispositis, globoideis, levibus impleta. Sporae (Figg. 19, 20, 21, 22) subpyramidales, cuneiformes usque irregulariter elongatae, 12–30(–35) μm longae, rubro- usque pallide nigro-brunneae. Paries superficiei externae, liberae sporarum polygonalis, diametro (6,5–)8–12 x 8–16 μm, parum convexus, 1–3 μm crassus, verrucis humilibus, irregularibus, saepe confluentibus ornatus. Paries laterum conjunctorum tenuior (0,5–1 μm), levis, sed superficies libera in caverna centrali rursus crassior (1–2 μm), levis vel verrucosa. Germinatio (Fig. 23) basidiis septatis, verticillos basidiosporarum ovoidearum ad septa et in apicibus producentibus. Basidiosporae more fermentorum germinantes, 1,5–4 x 5,5–9,5 μm.

Fig. 18. TS of a sorus of Tolyposporium laevigatum on Schoenus laevigatus showing the localisation of the mycelia and spore ball formation (type; for detailed explanation see the text above). Bar = 10 μm.

Figs. 19, 20, 21, 22. Spore balls and spores of Tolyposporium schoeni on Schoenus brevifolius (type) in LM and in SEM. Fig. 20 shows part of a large, bleached spore ball evidenciating the wedge-shaped to irregularly elongate spores and thecentral cavity of the ball with loosely arranged, globoid spores. Fig. 22 shows a broken spore ball with empty central cavity. Bars = 10 μm.

Sori (Fig. 17) in the flowers, completely hidden by the floral envelopes. The black, first agglutinated, later granular-powdery mass of spore balls is covering the surface of the proximal part of the filaments and also filling the aborted and deformed nuts which early split longitudinally. Layer of sporogenous hyphae apparently absent. Spore balls (Figs. 19, 20, 21, 22) variable in shape and size, ovoid, elongate or irregular, 50–90 x 60–120(–150) µm, dark reddish-brown to blackish-brown, opaque, composed of many (80 to several hundreds) of firmly united spores. Spores (Figs. 19, 20, 21, 22) subpyramidal, wedge-shaped to irregularly elongated, 12–30(–35) µm long, reddish- to light blackish-brown. The interior of large spore balls is empty or this central cavity may be filled with loosely arranged, globoid, smooth spores. The wall of the free, outer surface is polygonal, (6.5–)8–12 x 8–16 µm in diameter, slightly convex, 1–3 µm thick, provided with low, irregular, often confluent warts. Wall of contact sides thinner (0.5–1 µm), smooth, but the free surface in the cavity is thicker again (1–2 µm), smooth or verrucose. Germination (Fig. 23; of three and a half years old spores of the type specimen, on water-agar, after 1 day, at room temperature) results in septate basidia producing whorls of ovoid basidiospores at the septa and on the apex of the basidium, sterigmata lacking. Basidiospores germinate as yeasts measuring 1.5–4 x 5.5–9.5 µm.

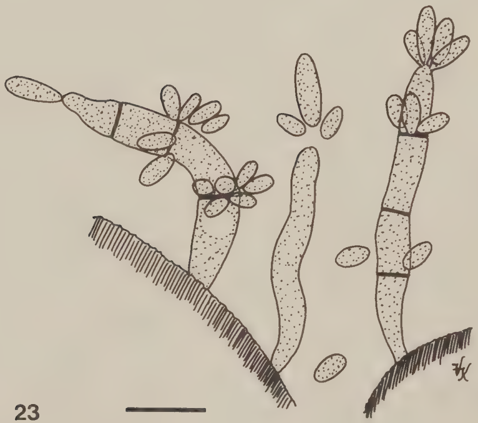

Fig. 23. Spore germination of nearly 5 years old Tolyposporium schoeni (Type; on water-agar, after 1 day, at room temperature). Bar = 10 µm.

Key to the Ustilaginales of Schoenus.

1. Spores single 2
– Spores in balls 3
2. Spore wall of uneven thickness (1–4 µm),
    light-refractive spots common .... Anthracoidea schoenus
– Spore wall even or slightly uneven (1–2.5 µm),
    light-refractive spots absent .... Anthracoidea andina
3. Spore balls loose, of (1–)2–15 spores .... Sorosporium solidum
– Spore balls compact, permanent 4
4. Spore balls 60–150 µm long, spores 12–35 µm long ... Tolyposporium schoeni
– Spore balls up to 85 µm long, spores up to 25 µm long 5
5. Spore balls of (2–)10–50 or more spores .... Tolyposporium kochianum
– Spore balls of 40–100 or more spores .... Tolyposporium laevigatum

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The authors are grateful to Dr. S. Tóth (Gödöllő, Hungary) for providing the Latin descriptions, to Professor N. Lundqvist (Stockholm, Sweden) for serving as pre-submission reviewer, for Dr. Karen L. Wilson (Sydney, Australia) for identifying the collection of Schoenus laevigatus. We further acknowledge the technical assistance of Mr. H. Schoppmann with SEM, of Mr. F. Albrecht with photographic work, and of Mrs. O. Ebinger with spore germinations (all from Tübingen, Germany). Thanks are also due to the Directors and Curators of the Herbaria H, PDD and ZT for loans of type specimens. This work was partly supported by the Deutsche Forschungsgemeinschaft.

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NEW SPECIES IN THE LICHEN FAMILY PARMELIACEAE (ASCOMYCOTINA) FROM AUSTRALASIA AND MALAYSIA

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ABSTRACT : The species, *Bulbothrix lordhowensis* Elix, *Xanthoparmelia austroalpina* Elix and *Xanthoparmelia purdiae* Elix from Australia; *Hypotrachyna galbinica* Elix from Malaysia; *Hypotrachyna simbuensis* Elix, *Hypotrachyna tariensis* Elix, *Parmotrema isidioinsuetum* Elix and *Parmotrema lambleyi* Elix from Papua New Guinea are described as new. *Bulbothrix klementii* Hale is reported for the first time from Australia.

Introduction

As a result of further study of the lichen family Parmeliaceae in Australasia and Malaysia (Elix 1994), I am describing 8 new species. Throughout the present work chemical constituents were identified by thin layer chromatography (Culberson 1972; Culberson, Culberson & Johnson 1981; Culberson & Johnson 1982; Elix & Ernst-Russell 1993; Elix, Johnston & Parker, 1988), high performance liquid chromatography (Feige et al., 1993) and comparison with authentic samples.

Bulbothrix lordhowensis Elix sp. nov. Fig. 1

Species cum thallo ut in *Bulbothrix queenslandica* sed ab hac specie acido norstictico continente differt.

Type: Australia. New South Wales. Lord Howe Island. On dead canopy branches in dry lowland forest, along track to Mutton Bird Point, 31°32'45"S, 159°05'E, 60 m, *J. A. Elix 32781*, 21.vi.1992; holo: CANB; iso: HO, MEL.

Thallus corticolous, adnate, pale mineral grey to grey-green, 1-3 cm in diam. *Lobes* linear to sublinear-elongate, di- or trichotomously branched, 0.3-1.0 mm wide, the margin conspicously bulbate-ciliate, bulbate cilia, shiny, dense, ± with forked apices which form a mat at the margins of the lobes. *Upper surface* plane or slightly convex, becoming cracked with age, sparsely to moderately isidiate, isidia cylindrical, simple, with black tips, less than 0.3 mm high. Medulla white. *Lower surface* black, rhizines moderate to dense, black, simple to dichotomously branched. *Pycnidia* and *apothecia* not seen.

Chemistry. Cortex K+ yellow, medulla K+ yellow, C-, P+ yellow-orange; containing atranorin, chloroatranorin, norstictic acid (major), two fluorescent unknowns (minor).

In gross morphology *B. lordhowensis* closely resembles *B. queenslandica* (Elix) Elix and *B. pigmentacea* (Hale) Hale, but the latter species is distinguished by the presence of a red pigment in the rhizines and the lower cortex. *B. lordhowensis* and *B. queenslandica* can be most readily distinguished chemically since the latter species contains no medullary compounds whereas *B. lordhowensis* contains norstictic acid. *B. ventricosa* (Hale & Kurok.) Hale from the high elevation cloud forest of South America also contains norstictic acid, has cylindrical isidia and a black lower surface but has much broader lobes (1-5 mm vs. 0.3-1 mm wide), larger thalli (3-5 cm vs. 1-3 cm diam.) and lacks the fluorescent unknowns in the medulla. To date *B. lordhowensis* appears to be endemic to Lord Howe Island where it is not uncommon on canopy branches of trees in lowland areas.

Specimens Examined

NEW SOUTH WALES. Lord Howe Island. Neds Beach Road at Malabar Hill Track, 31°31'16"S, 159°03'50"E, 10 m, on *Cryptocarya, J. A. Elix 32860,* 22.vi.1992 (ANUC); type location, on dead canopy branch, *J. A. Elix 32798,* 21.vi.1992 (ANUC).

Hypotrachyna galbinica Elix, Laily & Wahid sp. nov. Fig. 2

Species cum thallo ut in *Hypotrachyna sinuosa* sed ab hac specie thallo diminuto, lobis angustioribus et acido norstictico et acido galbinico continente differt.

Type: Malaysia. Sabah. On twigs, Panarlaban Spree, Gunung Kinabalu, *Willis R. Littke WL804,* 8.v.1974; holo: UKM.

Thallus corticolous, adnate to loosely adnate, yellow-green, 1-2 cm diam. *Lobes* sublinear, narrow, 0.5-1.5 mm wide, dichotomously branched, subascending apically, margins entire, black and shining, axils sinuous. *Upper surface* plane, emaculate, smooth, shining, sorediate; soralia terminal or subterminal, capitate, soredia fine, powdery, pale yellow at first, becoming blackened with age. Medulla white. *Lower surface* black shiny, minutely wrinkled, often pale at the tips, densely rhizinate; rhizines black, dichotomously or squarrosely branched, extending beyond the lobe in a dense mat. *Pycnidia* and *apothecia* not seen.

Chemistry. Cortex K+ yellow, medulla K+ yellow-red, C-, P+ orange; containing usnic acid (minor), galbinic acid (major), norstictic acid (major), salazinic acid (minor), gyrophoric acid (minor).

Morphologically this species closely resembles *Hypotrachyna sinuosa* (Sm.) Ach. but is distinguished by the smaller thallus, narrower lobes, and the more complex medullary chemistry. *P. sinuosa* contains medullary salazinic acid (major), consalazinic acid (minor) and rarely traces of norstictic acid whereas *H. galbinica* contains galbinic acid and norstictic acid as major components. Currently this rare endemic species is only known from the type locality.

Hypotrachyna simbuensis Elix sp. nov. Fig. 3

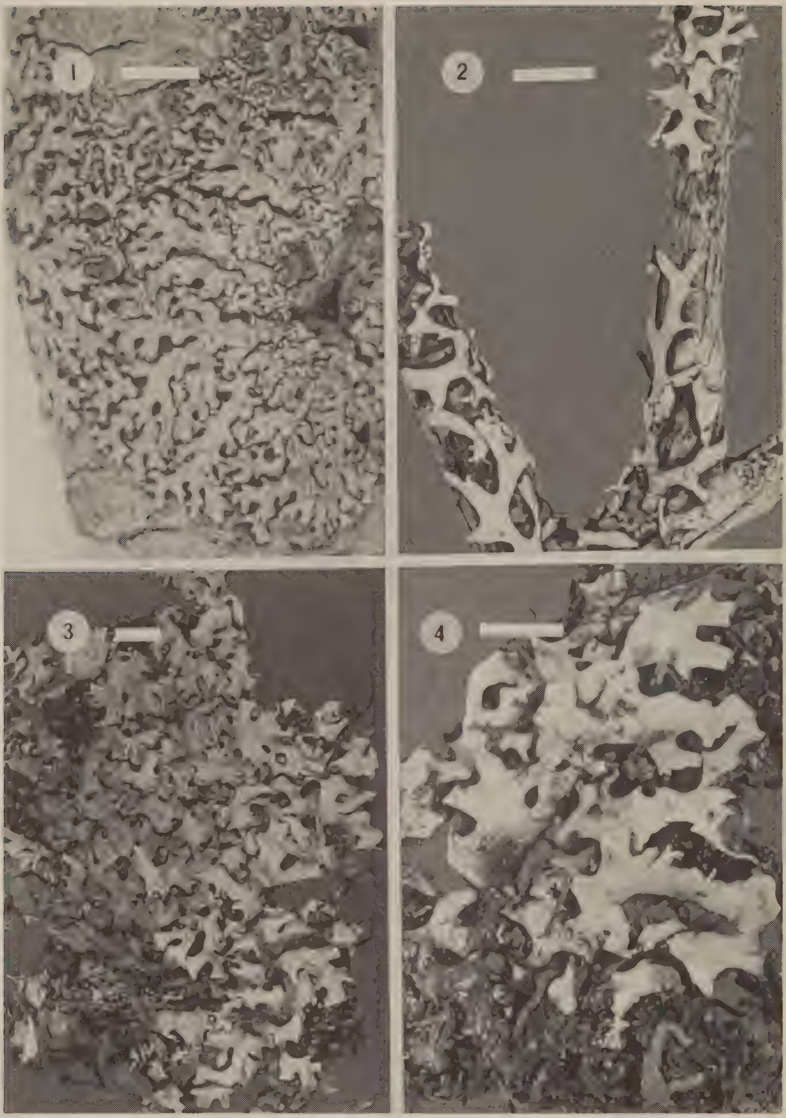
Species cum thallo ut in *Hypotrachyna sinuosa* sed ab hac specie thallo magno, lobis latioribus et acido fumarprotocetrarico et acido confumarprotocetrarico continente differt.

Type: Papua New Guinea. Simbu Province. On rocks, Lake Aunde, 3 km south-east of Mt. Wilhelm, 5°47'S, 145°07'E, 3660 m, *A. Mundua 121*, 4.xii.1982; holo: CANB; iso: H, LAE.

Thallus saxicolous, adnate to loosely adnate, yellow-green, 5-7 cm diam. *Lobes* sublinear, 1.0-4.0 mm wide, dichotomously branched, subascending apically, margins entire, black and shining, axils sinuous. *Upper surface* plane, emaculate, smooth, shining, sorediate; soralia terminal or subterminal, capitate, soredia fine, powdery, pale yellow at first, becoming blackened with age. Medulla white. *Lower surface* black shiny, minutely wrinkled, often pale at the tips, moderately rhizinate; rhizines black, densely dichotomously branched, extending beyond the lobe in a dense mat. *Pycnidia* and *apothecia* not seen.

Chemistry. Cortex K+ yellow, medulla K+ yellow-red, C-, P+ orange; containing usnic acid (minor), fumarprotocetraric acid (major), confumarprotocetraric acid (minor), protocetraric acid (trace), succinprotocetraric acid (trace).

Morphologically this species closely resembles *Hypotrachyna sinuosa* (Sm.) Ach. but is distinguished by the larger thallus, broader lobes, alternative rhizines and different medullary chemistry. *H. sinuosa* contains medullary salazinic acid (major), consalazinic acid (minor) and rarely traces of norstictic acid whereas *H. simbuensis* contains fumarprotocetraric acid



Figures 1-4. New species of Parmeliaceae: 1, *Bulbothrix lordhowensis* (holotype in CANB); 2, *Hypotrachyna galbinica* (holotype in UKM); 3, *Hypotrachyna simbuensis* (holotype in CANB); 4, *Hypotrachyna tariensis* (holotype in CANB). Scale bar = 5mm.

and confumarprotocetraric acid as major components. The rhizines in *H. sinuosa* are dense and dichotomously or squarrosely branched while in *H. simbuensis* the rhizines are moderate (not dense) but are densely dichotomously branched. Currently this rare endemic species is only known from the type locality.

Hypotrachyna tariensis Elix sp. nov. Fig. 4

Species cum thallo ut in *Hypotrachyna microblasta* sed ab hac specie acido salazinico continente differt.

Type: Papua New Guinea. Southern Highlands. On *Nothofagus* in *Nothofagus* forest, Tari Gap, 19 km south-east of Tari, 5°57'S, 143°05'E, 2200 m, *J. A. Elix 13319 & H. Streimann*, 17.xii.1982; holo: CANB.

Thallus corticolous, adnate to loosely adnate, yellow-green, *ca.* 5 cm diam. *Lobes* sublinear, 1.0-4.0 mm wide, dichotomously branched, margins entire, black and shining, axils sinuous. *Upper surface* plane, emaculate, smooth, shining, isidiate; isidia simple, cylindrical, submarginal. Medulla white. *Lower surface* black shiny, minutely wrinkled, often pale at the tips, densely rhizinate; rhizines black, densely dichotomously branched, extending beyond the lobe in a dense mat. *Pycnidia* and *apothecia* not seen.

Chemistry. Cortex K+ yellow; medulla K+ yellow then deep red, C-, P+ red-orange; containing usnic acid, salazinic acid (major), consalazinic acid (minor), norstictic acid (trace), protocetraric acid (trace).

This unique new species is distinguished by the broad, yellow-green lobes with cylindrical isidia, the medullary salazinic acid and the prominent, dichotomously branched rhizines. In overall growth form and in the development of isidia, this new species resembles *Hypotrachyna microblasta* (Vain.) Hale, but the latter is distinguished by the nature of the isidia and the presence of major amounts of medullary norstictic acid and galbinic acid. By contrast *H. tariensis* contains predominantly salazinic acid in the medulla. *H. tariensis* develops submarginal, simple, cylindrical isidia, whereas in *H. microblasta*, the isidia develop centrally and commonly become coralloid branched, sublobulate and ciliate. At present this species is only known from the type collection.

Parmotrema isidioinsuetum Elix sp. nov. Fig. 5

Species cum thallo ut in *Parmotrema tinctorum* sed ab hac specie lobi ciliata, angustioribus et acido diffractaico, acido barbatico et acido protocetrarico continente differt.

Type: Papua New Guinea. Central Province. On fallen rotten branch in lower montane forest with *Hopea, Sloanea* and *Castanopsis* on side of ridge, head of Goldie River, 44 km north-east of Port Moresby, 9°22'S, 147°30'E, 420 m, *H. Streimann & E. K. Naoni 14724*, 9.ii.1981; holo: CANB.

Thallus corticolous, loosely adnate, membranaceous, pale mineral grey, to 12 cm diam. *Lobes* irregular, 4-10 mm wide, with rotund apices, entire or crenate, margins sparingly ciliate, cilia up to 1 mm long. *Upper surface* dull, emaculate, isidiate; isidia sparse to dense, laminal and marginal, confluent or in scattered groups, simple or branched, thin cylindrical at first, fragile, becoming granular, irregularly inflated and subsorediate, brown tipped or concolorous. Medulla white. *Lower surface* smooth, shiny, black, with a broad, brown, naked marginal zone, sparsely rhizinate, rhizines simple, short, ca. 0.5-1.0 mm long, coarse. *Pycnidia* and *apothecia* not seen.

Chemistry. Cortex K+ yellow, medulla K-, C-, KC-, P-; containing atranorin, chloroatranorin, diffractaic acid (major), protocetraric acid (minor), barbatic acid (minor), 2-*O*-methylobtusatic acid (trace), norobtusatic acid (trace), 4-*O*-demethylbarbatic acid (trace).

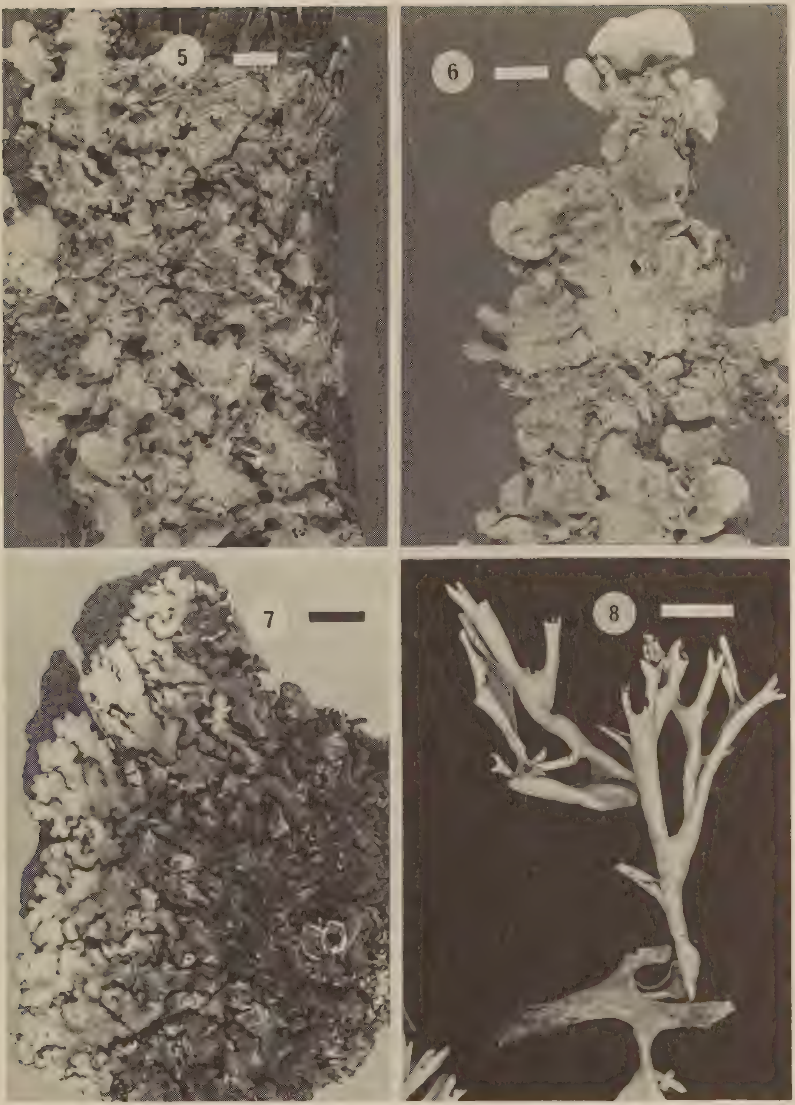
This new species is characterized by the sparsely ciliate lobes, the cylindrical isidia and the medullary diffractaic, barbatic and protocetraric acids. *Parmotrema isidioinsuetum* appears to be the isidiate counterpart of *P. praeinsuetum* (Kurok.) Streim. (a fertile primary species) and *P. insuetum* (Kurok.) Streim. (sorediate). All three of these species are sympatric, have identical medullary chemistry and comparable morphology, apart from the presence (or absence) and nature of the vegetative propagules. *P. isidioinsuetum* differs from *P. tinctorum* in the smaller thalli (5-12 cm cf. 10-30 cm diam.), narrower lobes (4-10 mm cf. 10-20 mm wide), the sparse cilia and medullary chemistry (*P. tinctorum* contains lecanoric acid). At present this new species is known only from the type locality.

Parmotrema lambleyi Elix sp. nov. Fig. 6

Species cum thallo ut in *Parmotrema tinctorum* sed ab hac specie medulla roseo-brunneo et acido secalonico B et acido secalonico C continente differt.

Type: Papua New Guinea. Central Province. On boughs of felled rainforest tree, Brown River, Grid Ref. EK 2185, 30 m, *P. W. Lambley 912*, 23.ii.1987; holo: CANB; iso: UPNG.

Thallus corticolous, loosely adnate, membranaceous, pale mineral grey or becoming brownish with age, to 6 cm diam. *Lobes* irregular, 8-20 mm wide, with rotund apices, entire or crenate, eciliate. *Upper surface* dull, emaculate, cortex sometimes cracking and flaking, isidiate; isidia sparse, laminal and submarginal, scattered, brown tipped or concolorous with the thallus, simple or branched, thin and cylindrical or rarely



Figures 5-8. New species of Parmeliaceae: 5, *Parmotrema isidioinsuetum* (holotype in CANB); 6, *Parmotrema lambleyi* (holotype in CANB); 7, *Xanthoparmelia austroalpina* (holotype in CANB); 20, *Xanthoparmelia purdieae* (holotype in CANB). Scale bar = 5 mm

irregularly inflated. Medulla pigmented brownish-pink throughout. *Lower surface* smooth, shiny, black, with a broad, brown, naked marginal zone, sparsely rhizinate, rhizines simple, short, *ca.* 0.5-2.0 mm long, coarse. *Pycnidia* and *apothecia* not seen.

Chemistry. Cortex K+ yellow, medulla K-, C-, KC-, P-; containing atranorin, chloroatranorin, secalonic acid B (major), secalonic acid C (major), unknown (trace).

This unique new species is characterized by the pigmented medulla containing secalonic acids B and C, the cylindrical isidia and lack of cilia. *P. lambleyi* possibly has affinities with *Parmotrema cryptoxanthum* (des Abbayes) Hale from east Africa as this species has a similarly pigmented medulla but is ciliate, produces pustules rather than isidia and contains medullary echinocarpic acid as well as the secalonic acid derivatives. At present this new species is only known from the type locality.

Xanthoparmelia austroalpina Elix sp. nov. Fig. 7

Species cum thallo ut in *Xanthoparmelia nebulosa* sed ab hac specie thallo arcto adnato et acido pertusarico et acido dehydroconstipatico continente differt.

Type: Australia. Victoria. On basalt rocks in exposed subalpine grasslands with basalt outcrops, Ruined Castle, Bogong High Plains, 16.5 km SSE of Mt. Beauty, 36°52'S, 147°15'E, 1620 m, *J. A. Elix 40582 & H. Streimann*, 18.ii.1994; holo: CANB; iso: HO.

Thallus foliose, moderately adnate to adnate on rocks, yellow green but sometimes becoming deep olive-green or blackening with age, 6-10 cm in diam. *Lobes* subirregular, strongly imbricate, contiguous or not, 1-2.5 (-5.0) mm wide, the apices crenulate, more or less rotund; secondary lobes narrower, up to 1.0 mm wide, imbricate and entangled, sometimes overgrowing the marginal lobes. *Upper surface* shiny, emaculate, becoming rugose and cracked with age, lacking soredia and isidia but with numerous pycnidia, often black-margined particularly towards the apices of the lobes. Medulla white. *Lower surface* pale ivory to brown, moderately rhizinate, rhizines yellow-brown to brown, simple, slender. *Pycnidia* common; conidia bifusiform, 0.5 x 6-7 µm. *Apothecia* adnate or short stipitate, 2-7 mm in diam.; disc concave, dark brown, the margin involute at first but later becoming undulating and developing irregular cracks; spores 8.5-12 x 5-7 µm.

Chemistry: Cortex K-; medulla K-, C-, KC-, P-; containing usnic acid, dehydroconstipatic acid (minor), pertusaric acid (major), constipatic acid (trace) and protoconstipatic acid (trace).

Previously this species has been confused with *Xanthoparmelia nebulosa* (Kurok.) Elix & Johnston since both are characterized by imbricate lobes, a pale lower surface, the lack of soredia and isidia and the negative medullary reactions due to the presence of aliphatic acids. However *X. nebulosa* is loosely adnate and contains caperatic acid and roccellic acid, whereas *X. austroalpina* is moderately adnate to adnate and contains pertusaric acid and dehydroconstipatic acid. *X. austroalpina* is a relatively rare species on exposed alpine and subalpine rocks in south eastern Australia (N.S.W., Vic.).

Specimens Examined

NEW SOUTH WALES. Kosciusko National Park, along Perisher Creek, 4 km NE of Guthega, 1520 m, on granite rocks, *J. A. Elix 5808, 5809*, 14.iii.1979 (ANUC). VICTORIA. Basalt Hill, Bogong High Plains, 20 km SE of Mt. Beauty, 36°53'S, 147°18'E, 1650 m, on basalt rocks, *J. A. Elix 40438 & H. Streimann*, 18.ii.1994; type locality, *J. A. Elix 40590 & H. Streimann*, 18.ii.1994 (ANUC), *J. A. Elix 40590 & H. Streimann*, 18.ii.1994 (ANUC, CANB).

Xanthoparmelia purdieae Elix sp. nov. Fig. 8

Species cum thallo ut in *Xanthoparmelia convoluta* sed ab hac specie lobi lineariter elongatis, angustatis et acido fumarprotocetrarico continente differt.

Type: Australia. Queensland. On soil over stony plateau in sparse low shrubland with scattered *Acacia catenulata* and *A. clivicola*, Idalia National Park, ca. 12 south of Idalia Homestead on walk to Mountain Rock Hole, 24°57'S, 144°47'E, *R. W. Purdie 4207B*; holo: CANB.

Thallus foliose, unattached on soil, pale yellow-green in colour, 1-3 cm in diam. *Lobes* linear-elongate, convolute, contorted, 1.5-4.0 mm broad when flattened but 0.8-2.0 mm wide when dry and convoluted. *Upper surface* smooth, emaculate, becoming rugulose and cracked in older lobes, soredia and isidia absent. Medulla white. *Lower surface* yellow-green, very sparsely rhizinate, rhizines simple, concolorous with the lower surface. *Pycnidia* and *apothecia* not seen.

Chemistry. Cortex K-, medulla K+ dingy yellow-brown, C-, KC-, P+ brick-red; containing usnic acid, fumarprotocetraric acid .

This characteristic species is distinguished by the narrow, linear-elongate, convoluted lobes and the presence of medullary fumarprotocetraric acid. This species resembles *Xanthoparmelia convoluta* (Krempelh.) Hale, but these two taxa show consistent morphological and chemical differences. *X. purdieae* differs morphologically in having narrower, more linear-elongate lobes with a yellow-green lower surface, whereas the lobes of *X. convoluta* are broader (3.5-8.0 mm broad when flattened cf. 1.5-4.0 mm wide) and the lower surface is pale to dark brown. Chemically *X. purdieae* contains medullary fumarprotocetraric acid whereas *X. convoluta* contains salazinic acid and consalazinic acid. These two species also show different geographic distributions. To date this new species is only known from the type locality while *X. convoluta* occurs scattered on bare earth in mallee scrub, in the drier areas of southern South Australia and western Victoria.

New Records

Bulbothrix klementii (Elix & Stevens) Hale, *Smithsonian Contr. Bot.* **32**: 18 (1976).

This species has previously been reported from Venezuela.

Specimens Examined

NEW SOUTH WALES. Lord Howe Island. Track to Little Island, near Salmon Beach, 31°33'30"S, 159°04'30"E, 5 m, on dead tree, *J. A. Elix 32673*, 20.vi.1992 (ANUC); near junction of tracks to Mutton Bird Point and Intermediate Hill, 31°32'43"S, 159°04'48"E, 60 m, on base of dead palm, *J. A. Elix 32748*, 20.vi.1992 (ANUC).

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STUDIES ON AMANITA (AMANITACEAE) IN WEST VIRGINIA AND ADJACENT AREAS OF THE MID-APPALACHIANS. PRELIMINARY RESULTS

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Summary

A project to describe the taxa of *Amanita* present in West Virginia and adjacent areas of the mid-Appalachians was undertaken. A description of the major forest types in the state is provided. Distribution data from previous collection lists, checklists, and the general literature are supplemented by collections made by the authors and others in recent years and by review of older herbarium material. The result is an extensively annotated list including brief macroscopic descriptions, spore measurement data, and other information on collections examined. A key is provided to all taxa listed.

INTRODUCTION

This paper, which presents a working list of species in the genus *Amanita* Pers. reported from or known to occur in West Virginia and adjacent areas of the mid-Appalachians, was developed originally by Tulloss in the form of a checklist for the aid of those attending the 1985 North American Mycological Association (NAMA) foray in Canaan Valley State Park near Davis, West Virginia. For the most part historical information was collected during development of a recent checklist of West Virginia fungi under development by Stephenson *et al.* (1994). Results of the authors' study of regional specimens are also included in brief.

While this flora of West Virginia *Amanita* species is certainly incomplete, we believe that the information presented herein will provide some sense of the richness of the *Amanita* taxa of the study region and will prove useful in identifying collections of *Amanita* from the area of interest. This list contains 77 distinct taxa, described or provisional, of which at least 26 are as yet apparently undescribed. There are several cases of possible misapplication of epithets in our sources. In these cases, we have retained the usage of the references in question while noting the taxonomic and/or nomenclatural difficulties.

In particular, there are cases of questionable application of European names; for example, C. Bas, Rijksherbarium, Leiden, the Netherlands, noted during the 1984 Northeast Mycological Foray that *A. virosa* Lamarck, in Europe, always has an irregular pileus and a northern or montane distribution—unlike the entity to which the name is applied in North America. D. T. Jenkins (1986) has noted that there are a number of white *Amanita* species bearing some similarities to *A. verna* (Bull.:Fr.) Lamarck and that the concepts of these taxa are not well separated. Tulloss has examined a number of the relevant types in this group (unpub. data), and we believe that our identifications are consistent and correct applications of the names (*e.g.*, *A. magnivelaris*). Whether the European *A. verna* actually occurs in the United States, we do not know.

The number of named taxa in *Amanita* section *Vaginatae* is a very small fraction of the number of entities existing in the North American *Amanita* flora that obviously must be assigned to that section. Among the names certainly or probably wrongly applied in the United States are *A. caesarea* (Scop.:Fr.) Pers., *A. ceciliae* (B. & Br.) Bas, and *A. nivalis* Grev. Tulloss (unpub. data) also has reservations concerning the North American application of *A. fulva* (Schaeff.:Fr.) Pers. *Amanita vaginata* (Bull.:Fr.) Vitt. is a poorly understood entity despite the widespread use of that name.

Tulloss *et al.* (1992) demonstrated that Colombian and Central American collections referred to *A. rubescens* Pers. represented a quite distinct taxon—*A. brunneolocularis* Tulloss *et al.* It is probable that the eastern North American mushroom commonly called *A. rubescens* will turn out to be different from the European species also (Tulloss and Lindgren, 1994).

It should be emphasized that a number of species of *Amanita* are known to be deadly poisonous and that several of these are present in the mycoflora of West Virginia. While some species of *Amanita* are reportedly edible, it is wisest to avoid eating mushrooms belonging to this genus. *We strongly urge the reader not to experiment with edibility in this genus.* A detailed discussion of *Amanita* poisonings is presented by Ammirati *et al.* (1985).

THE STUDY AREA

The greater part of West Virginia, including all of the state west of the mountains, is characterized by mixed hardwood forests in which a large number of different species of trees are present with considerable variation as to exactly what species are dominant at a particular site. Widespread dominants include beech (*Fagus* *grandifolia* Ehrh.), yellow-poplar (*Liriodendron tulipifera* L.), basswood (*Tilia heterophylla* Vent.), sugar maple (*Acer saccharum* Marsh.), buckeye (*Aesculus octandra* Marsh.), red oak (*Quercus rubra* L.), white oak (*Q. alba* L.), hemlock [*Tsuga canadensis* (L.) Carr], and hickory (*Carya spp.*). These same species also make up the forests that occur at lower elevations in the mountains of the central portion of the state. However, northern hardwood forests—in which beech, red maple (*Acer rubrum* L.), yellow birch (*Betula lutea* Michx. f.), and black cherry (*Prunus serotina* Ehrh.) are the characteristic dominants—generally occur at elevations above 762 m.

Subalpine coniferous forests dominated by red spruce (*Picea rubens* Sarg.) occur at the very highest elevations (usually above 1219 m, but sometimes as low as 975 m). At a few localities, balsam fir [*Abies balsamea* (L.) Mill.] is present as an associate of red spruce (Core, 1966; Stephenson and Adams, 1986). As a result of the extensive logging and frequent fires that occurred throughout the mountains of West Virginia between 1870 and 1920, the original subalpine coniferous forests were almost completely eliminated. As a result, the present-day distribution of this forest type is much more restricted than was the case in the past. Numerous high-elevation areas are largely barren of trees and now support a dense growth of shrubs, particularly blueberries (*Vaccinium spp.*) and other ericads. Wetland areas generally called bogs or glades also occur at a number of places in the mountains of the state. Although these wetlands typically support a mosaic of different plant communities, their most distinctive feature is the relative dominance of mosses—*Sphagnum spp.* and (to a lesser extent) *Polytrichum spp.* The largest and best-known example of such a wetland is Cranberry Glades (elevation 1029 m) in Pocahontas County (Stephenson, 1993).

The major species of trees comprising the forests of the portion of the state east of the mountains (essentially the eastern panhandle) are various species of oak, with chestnut oak (*Q. prinus* L.), black oak (*Q. velutina* Lam.), scarlet oak (*Q. coccinea* Muenchh.), white oak, and red oak the usual dominants. Pines [including Virginia pine (*Pinus virginiana* Miller) and pitch pine (*P. rigida* Miller)] are often important associates of oak, especially on drier sites (Core, 1966).

Braun (1950) included most of West Virginia in the Mixed Mesophytic Forest Region, but the eastern part of the state was considered as falling within the Oak-Chestnut Forest Region. As delimited by Braun, the Mixed Mesophytic Forest Region also encompasses eastern Ohio, southwestern Pennsylvania, and eastern Kentucky. The Oak-Chestnut Forest Region includes the western portion of Virginia, central and eastern Pennsylvania, and northern New Jersey. For the most part, the forests of these areas are compositionally rather similar to the forests found in adjacent areas of West Virginia considered part of the same forest region (Stephenson *et al.*, 1993). For example, collections of *Amanita* cited from Giles and Craig Counties in western Virginia are from oak-dominated forests containing the same species of trees that characteristically make up the forests of eastern West Virginia.

Average annual precipitation in West Virginia ranges from less than 65 cm to more than 170 cm and is generally well-distributed throughout the year with no pronounced dry seasons.

MATERIALS & METHODS

The taxonomic portion of this paper contains brief descriptions of species reported from the region of interest. The species are assignable to both subgenera and to all six sections of the genus recognized by Corner and Bas (1962). Each section is introduced by a short description of characters of the section and a list of those species (if any) that, while not yet reported from West Virginia or immediately surrounding areas, are known from localities suggesting a range encompassing West Virginia. Taxa not encountered in our study, but reported from regions relatively close to the borders of West Virginia, and unencountered taxa appearing in checklists of fungi found in the state are presented in a separate list in reduced type after the species descriptions for each section of the genus.

Certain macrochemical tests are useful for the study of *Amanita* in the field and laboratory. *Amanita bisporigera* and *A. virosa sensu auct. amer.* are both among the white species that exhibit a strong yellow reaction when a drop of KOH solution is placed on the pileus. The reaction is particularly strong if a 5-10% solution is used. Many species of *Amanita* contain the enzyme tyrosinase, which will facilitate oxidation of various phenolic compounds such as phenol, L-tyrosine, and paracresol; the colors produced vary with the species and the reagent and range from ruby to orange-brown to purple-brown. Syringaldazine dissolved in 95% ethanol (0.5% solution by weight) will produce a beautiful lilac to purple reaction if the enzyme laccase is present in sufficient concentration in a mushroom. While this is not commonly the case in *Amanita*, one can see the reaction most strongly in some species of section *Amidella* and the rooting part of the bulbs of some members of section *Lepidella* (Tulloss, unpub. data). The Wieland test for the presence of amatoxins [see, for example, Ammirati *et al.* (1985)] is another example of a qualitative, macrochemical test.

Terminology, abbreviations, and methodology are as described in Tulloss *et al.* (1992) as modified by Tulloss (1993, 1994).

When a fruiting body is described as “small,” it is meant that the stipe length ≤ 70 mm; when described as “medium-sized,” > 70 mm, but ≤ 130 mm; when described as “large,” > 130 mm. Fruiting bodies can vary in size considerably depending upon meteorologic and other conditions.

Dimensions for spores are given using notation of the form *(a-) b - c (-d)*. The range *b* - *c* contains a minimum of 90% of the measured values. If less than 100% of the measured values fall within the range *b* - *c*, then *a* (if such exists < *b*) represents the smallest value measured and *d* (if such exists > *c*) represents the largest value measured. If the spore measurements are from the literature rather than having been made by us, the bracketed triple of numbers indicating number of spores measured (Tulloss *et al.*, 1992) is omitted.

Spore measurements for a taxon are listed following the symbol **SP**, and the list of regional collections examined for each species follows the symbol **CE**.

Undescribed entities first encountered by Tulloss in West Virginia are given "species numbers" with an initial "W." Unnamed taxa common to both this and Tulloss' personal New Jersey checklist can be identified by the "species number" (not preceded by a "W") that is applied in both lists. Species given a "number" beginning with "N" were first encountered by Tulloss north of the Mason-Dixon line and east of Ohio; those beginning with "O" were first encountered by Tulloss in Ohio; those beginning with "S," in South Carolina; and those beginning with "V," in Virginia.

With the following exceptions, herbarium codes used follow Holmgren *et al.* (1990):

DTJ - personal herbarium of D. T. Jenkins, University of Alabama at Birmingham, U.S.A.
RBHATT - personal herbarium of R. P. Bhatt
RET - personal herbarium of R. E. Tulloss.

Tulloss' collection numbers are of the form *m*[-*n*]-*p*-*a* where *m*, *n*, and *p* stand for integers [indicating month, day (if present) and year, respectively] and where *a* indicates a character string distinguishing collections made on a single day. All collections without herbarium citation are in RET.

Although synonymy might be omitted from a preliminary presentation of this sort, we have included selected taxonomic synonymy when a synonym might be as familiar or more familiar to users of this document than the nomenclaturally correct name.

1	Bas (1969)	**17**	Tulloss (unpub.-b)
2	Bas (1982)	**18**	Anonymous (no date)
3	Brown *et al.* (1977)	**19**	Moser (1983)
4	Gilbert (1933)	**20**	Jenkins and Tulloss (unpub.)
5	Jenkins (1977)	**21**	Tulloss and Jenkins (1985)
6	Jenkins (1979)	**24**	Linder (1937)
7	McIlvaine and Macadam (1902)	**25**	Jenkins (1986)
8	McKnight and McKnight (1978)	**26**	Tulloss (1988)
9	O. K. Miller, Jr. (pers. comm.)	**29**	Stephenson and Adams (1986)
10	Millspaugh (1892)	**31**	Peck (1892)
11	Millspaugh (1913)	**35**	Tulloss (1990a)
12	Millspaugh and Nuttall (1896)	**36**	Tulloss (1990b)
13	Rieffenberger *et al.* (1978)	**38**	Tulloss (1993)
14	Smith *et al.* (1976)	**41**	Bills *et al.* (1986)
15	Thiers (1982)	**42**	Stephenson *et al.* (1994)
16	Tulloss (unpub.-a)	**43**	Branson (1990)

Table 1. Correspondence between literature cited and reference numbers.

In the taxonomic part of this paper, one or more integers in parentheses follow each entry. These numbers refer to items in the list of literature cited. The correspondence between the numbers and the entries in that list are provided in table 1. For each taxon, the relevant bibliographical item(s) include(s) the source of the record and/or the earliest report of the taxon from the general area covered by the checklist.

TAXONOMIC PART

Fruiting bodies belonging to taxa in *Amanita* may be recognized by the typical form of the tissue of the stipe, the bilateral trama of the lamellae, and the non-glutinous nature of the universal veil. The degree to which the divergence of the bilateral lamella trama is manifested varies greatly from species to species (Tulloss, 1993; 1994), but is consistent within a given taxon. The form and breadth of the lamella trama as a whole, along with the structure and depth of the subhymenium, are extremely valuable characters in *Amanita* taxonomy (Tulloss, 1993; 1994). Tulloss (1993) provides an account of methods for the study and description of this important tissue.

The universal veil varies from pulverulent to membranous and saccate. The variation is correlated in part to the relative frequencies of filamentous, undifferentiated hyphae and inflated cells in this tissue.

The partial veil is absent or evanescent in a number of taxa in the genus. Even when it is persistent and membranous, this structure presents some difficulty for anatomical analysis because collapsed or collapsing inflated cells (the function of which is to allow separation of the lamella edges from the partial veil) may be strewn on the upper surface and confused with inflated cells that are part of the partial veil's internal structure. Often a membranous partial veil will have radially arranged fascicles of filamentous, undifferentiated hyphae as a significant component (Tulloss *et al.*, 1992; Tulloss, 1993; Tulloss, 1994).

The stipe tissue consists of longitudinally arranged, usually clavate, inflated cells that are almost always terminal on branching, filamentous, undifferentiated hyphae. Either the inflated cells, called *acrophysalides*, or the hyphae may be dominant. Examples of the stipe context anatomy are provided by Bas (1969: figs. 19-24). The context of the pileus is comprised of analogous elements; however, they are often lacking in any obvious orientation with the exception of the region immediately below the pileipellis. The pileipellis is always well-defined in the taxa known from the region of study and is composed for the most part of interwoven, filamentous, undifferentiated hyphae (which quite frequently have a distinct subradial orientation and are often gelatinized at the surface). Between 15 and 20 taxa of *Amanita* in North America lack a well-defined pileipellis (Tulloss, unpub. data). Vascular hyphae (aseptate hyphae of irregular diameter with refractive contents that are often poorly soluble in 3% KOH solution) may be present in all tissues and sometimes are found in densely tangled knots (Tulloss, 1994).

Corner and Bas (1962) provided a key to two subgenera and six sections of *Amanita* that was refined by Bas (1969). A variant is provided by Jenkins (1986). Bas' key is duplicated here with minor modification for the benefit of the reader:

1. Spores amyloid. Margin of pileus rarely radially sulcate. Lamellulae often attenuate.. Subgenus *Lepidella*.
  2. Universal veil pulverulent or breaking up into flocks, warts, scales, patches, belts or crusts on pileus and stipe and sometimes disappearing completely from base of stipe. If bulb of stipe marginate, then universal veil floccose or forming conical warts, at least at center of pileus, and never provided with (sub)membranous outer layer.
    3. Margin of pileus not appendiculate. Pileipellis often deeply colored. Spores globose to ellipsoid, mostly < 10 μm, rarely up to 12 μm long. Partial veil membranous, rarely fugacious.. Section *Validae*.
    3. Margin of pileus appendiculate. Pileipellis rarely deeply colored. Spores globose to bacilliform, rather often > 10 μm long. Partial veil membranous to friable.. Section *Lepidella*.
  2. Universal veil circumscissile, limbate or saccate.
    4. Universal veil circumscissile or limbate, breaking up into submembranous, rarely pulverulent or floccose patches on pileus and leaving a slight, (sub)membranous limb or fragments of a limb at base of stipe, or else bulb distinctly marginate. Remnants of universal veil never conical warts.
      5. Margin of pileus appendiculate. Spores broadly ellipsoid to bacilliform. Partial veil membranous, friable or fugacious.................................. Section *Lepidella*.
      5. Margin of pileus not appendiculate. Spores globose to subglobose. Partial veil membranous.. Section *Phalloideae*.
    4. Universal veil saccate, forming a membranous sac at base of stipe and only occasionally one or a few membranous patches on pileus; but sometimes inner layer of universal veil friable and forming scales, patches or powder on pileus.
      6. Pileipellis often distinctly colored. Spores usually globose to ellipsoid, infrequently elongate to cylindric, rarely bacilliform. Partial veil membranous. Universal veil without friable inner surface layer. Lamellae not strongly darkening after drying.. Section *Phalloideae*.
      6. Pileipellis usually white or a shade of brown. Spores usually broadly ellipsoid to bacilliform. Partial veil often friable. Universal veil often with friable inner surface layer. Lamellae often darkening strongly on drying slowly at low heat.. Section *Amidella*.
1. Spores inamyloid. Margin of pileus usually radially sulcate. Lamellulae

nearly always truncate.. Subgenus *Amanita.*

7. Stipe with bulbous base. Universal veil usually friable, sometimes limbate.. Section *Amanita.*

7. Stipe without bulbous base. Universal veil frequently saccate, occasionally friable.. Section *Vaginatae.*

SUBGENUS *Amanita* SECTION *Amanita*

The species of this section have inamyloid spores. This feature is usually accompanied by a striate pileus margin and lamellulae that are sharply truncate as opposed to having their end nearest the stipe narrowing (attenuate). The base of the stipe is bulbous for all species in the section. Sometimes the bulb is easily seen only in an immature "button" specimen. In separating taxa in the section, the color of the pileus, the form of the universal veil remnants around the top of the bulb, and the presence of an annulus are all important characters.

Not yet collected in the region, but to be expected: *Amanita wellsii* (Murr.) Sacc. has been collected in North Carolina and well north of the U.S.-Canada border; in Canada, it is reportedly associated with alder (*Alnus spp.*).

KEY

1. Universal veil on stipe as thin layer of pulverulence on top of bulb at base of stipe or distributed along stipe.
   2. Pileus red to reddish orange with long striate margin and universal veil in pulverulent warts; stipe exannulate from early development; universal veil distributed over stipe as yellow pulverulence or pulverulent warts; spores (8.4-) 9.1 - 11.5 (-12.6) × (5.6-) 6.3 - 7.9 (-8.0) μm, with Q = 1.38 - 1.55.......... *Amanita parcivolvata.*
   2. Not as above. In particular universal veil on stipe as a thin layer of pulverulence appressed to the top of the basal bulb.
      3. Pileus gray or brownish gray with concolorous pulverulence and long marginal striations; stipe exannulate from early development; spores (6.0-) 6.5 - 9.0 (-10.5) × (5.2-) 5.5 - 7.2 (-9.0) μm, with Q = 1.15 - 1.31.......... *Amanita farinosa.*
      3. Pileus pale tan to sordid tan to yellowish tan with paler pulverulence and pulverulent warts and with rather short marginal striations; stipe with white, membranous annulus at first; spores (5.9-) 7.3 - 10.2 (-14.2) × (4.8-) 6.2 - 8.8 (-14.2) μm, with Q = (1.08-) 1.10 - 1.25 (-1.36)........................... *Amanita crenulata.*
1. Universal veil on stipe base as set of complete or broken rings, as ocreate or cothurnate collar, as membranous or submembranous flap, or as encircling limb.
   4. Pileus silvery white to off-white or shade of yellow, orange, or red; universal

veil on stipe base as complete or broken rings above bulb; stipe always annulate; basidiocarps medium to large.

5. Pileus silvery white to off-white; stipe discoloring yellowish where handled; spores (Jenkins, 1986) 7.9 - 14.1 × 6.3 - 9.4 μm, with Q = 1.41............ *Amanita muscaria* var. *alba*.

5. Pileus dominantly yellow with yellow-orange or orange or orange-red disc or (less often) entirely yellow-orange; spores (7.0-) 8.7 - 12.2 (-14.8) × (5.9-) 6.5 - 8.2 (-9.5) μm, with Q = 1.30 - 1.49................................ *Amanita muscaria* var. *formosa*.

4. Differing in one or more characters from the above.

6. Basal bulb with ocreate or cothurnate collar.

7. Pileus yellow-orange; universal veil yellow; spores (Jenkins, 1986) 7.0 - 10.2 × 7.0 - 10.2 μm, with Q = 1.01.. *Amanita frostiana*.

7. Not as above.

8. Pileus yellow, disc sometimes darkening with exposure; annulus soon shredding and disappearing; spores (6.3-) 7.3 - 9.8 (-12.6) × (5.6-) 6.6 - 9.1 (-11.9) μm, with Q = 1.05 - 1.11... *Amanita species 32*.

8. Not as above; especially, having persistent annulus.

9. Medium to large basidiocarp; pileus yellowish or cream with darker disc (buff to tan to brown); spores (Jenkins, 1986) 7.9 - 13.2 × 6.3 - 7.9 μm, with Q = 1.43.. *Amanita pantherina* var. *velatipes*.

9. Not as above.

10. Pileus with long striate margin and white or pallid, sometimes tan or brown over disc; spores (6.6-) 7.0 - 11.2 (-15.0) × (5.2-) 5.6 - 8.4 (-8.7) μm, with Q = 1.22 - 1.39... *Amanita pantherina* var. *multisquamosa*.

10. Pileus with short or medium marginal striation and bright yellow; spore data unknown.. *Amanita species W2*.

6. Basal bulb with flap of volval material or encircling limb.

11. Pileus pale yellow to yellowish cream; volva on bulb as an encircling limb; spores 8.5 - 11.0 (-14.8) × (5.5-) 6.0 - 7.2 (-7.5) μm, with Q = 1.59.. *Amanita agglutinata*.

11. Pileus yellow; volva on bulb as a membranous flap; spores (Jenkins, 1977) 8.7 - 10.2 × 6.3 - 7.0 μm, with Q = 1.40.............................. *Amanita russuloides*.

1. *AMANITA AGGLUTINATA* (B. & C. *in* B.) Lloyd (16)

This mushroom is small and gregarious with a viscid, pale yellow to yellowish cream pileus and an exannulate white to whitish stipe. It has a volval remnant in the form of an encircling whitish limb at the joining of bulb and stipe. The volval material on the pileus consists of pale, rather thick warts that contain plentiful vascular hyphae. Jenkins (1986) states that *A. agglutinata* is very rare and that the pileus is areolate in the type, which was originally described as "white." Nineteenth century descriptions used the word "white" very loosely (Tulloss, 1990b), as is apparently the case here. Our collection was made under species of oak, including white oak and post oak (*Q. stellata* Wang.).

SP: [20/1/1] 8.5 - 11.0 (-14.8) × (5.5-) 6.0 - 7.2 (-7.5) μm; **L** = 10.5 μm; **W** = 6.6 μm; Q = (1.40-) 1.42 - 1.77 (-2.28); **Q** = 1.59.

CE: KY—Laurel Co. - Levi Jackson Wilderness Trail St. Pk., David C. Tulloss *s.n.* [Tulloss 7-20-87-C].

2. AMANITA CRENULATA Peck (16, 36)

This small to medium mushroom has a pale cream to sordid tan or beige pileus sometimes with yellowish tint, often with dense covering of paler, floccose warts and scales The universal veil material may be found as a powder on the upper half to third of the bulb, which may have a scant, submembranous, whitish, appressed limb or collar. The original description states that the pileus is whitish; however, see discussion of "white" given under *A. agglutinata*, above. In the case of this species, water color paintings of paratypes exist showing the pileus to be the color(s) we ascribe to the species (Tulloss, 1990b). This species sometimes is found in association with *A. muscaria* var. *formosa* and occurs in deciduous forests containing oak as well as under Norway spruce [*Picea abies* (L.) Karst.] and under white pine (*Pinus strobus* L.) and red pine (*P. resinosa* Ait.) in August through November. This species may be found in large numbers in September and October. POISONOUS.

SP: [40/2/1] (6.3-) 7.3 - 10.5 × 5.6 - 9.1 μm; **L** = 8.2 - 8.4 μm; **L'** = 8.3 μm; **W** = 6.8 - 7.0 μm; **W'** = 6.9 μm; Q = (1.04-) 1.05 - 1.36 (-1.38); **Q** = 1.16 - 1.21; **Q'** = 1.18.

CE: PA—Westmoreland Co. - Greensburg, Twin Lakes Co. Pk., Emily Johnson *s.n.* [Tulloss 11-30-85-EJ1].

3. AMANITA FARINOSA Schw. (5, 11, 16, 42)

This is a small, delicate species. The pileus is pale brownish gray and has a deeply striate margin. The stipe lacks an annulus, is white or pallid, and terminates in a small bulb that has grayish powder of the universal veil appressed on its upper portion. From a quick look at the pileus, some collectors may judge this entity to be a relative of *A. vaginata*; however, there is a small, but distinct bulb. The WV collection was made in an area dominated by red spruce, yellow birch, and hemlock; the species is also found in beech-oak-hickory forests.

SP: [80/4/4] (6.0-) 6.5 - 9.0 (-10.5) × (5.0-) 5.5 - 7.2 (-9.0) μm; **L** = 7.3 - 8.0 μm; **L'** = 7.7 μm; **W** = 6.0 - 6.5 μm; **W'** = 6.3 μm; Q = (1.03-) 1.08 - 1.40 (-1.47); **Q** = 1.15 - 1.31; **Q'** = 1.21.

CE: VA—Augusta Co. - George Washington Nat. For., Todd Lk. Campground, D. C. & R. E. Tulloss 8-22-82-B. WV—Preston Co. - Brookside, ix.1900 H. C. Beardslee *s.n.* (BPI). Randolph Co. - Monongahela Nat. For., Otter Creek Wilderness, Gillian *s.n.* [Tulloss 8-2-85-B]. Tucker Co. - Deer Run Tr., Canaan Valley St. Pk., R. E. Tulloss 8-3-92-D.

4. *AMANITA MUSCARIA* var. *FORMOSA* Pers. (10, 11?, 16, 43)

This is a medium-sized to large mushroom usually with a bright yellow pileus, although the disc may be orange or reddish orange or pigment may be washed out by rain. The stipe is annulate and white. One or more rings of off-white to dingy cream volval material are often present just above a marked basal bulb. Volval material on the pileus is concolorous with that on the stipe and may be present in scattered warts. All varieties of *A. muscaria* (L.:Fr.) Pers. share the distinctive rings of volva on the lower stipe. Collections cited occurred under red pine or white pine. POISONOUS.

SP: [80/4/4] (9.2-) 9.5 - 12.2 (-14.8) × (6.0-) 6.5 - 8.2 (-9.5) μm; **L** = 10.1 - 11.4 μm; **L'** = 10.8 μm; **W** = 7.2 - 7.8 μm; **W'** = 7.5 μm; Q = (1.28-) 1.35 - 1.56 (-1.70); **Q** = 1.41 - 1.49; **Q'** = 1.44.

CE: WV—Marion Co. - Fairmont, Fairmont St. Coll. campus, 30.x.1980(?) S. L. Stephenson 270 (FWVA), 13.ix.1982 Thais Salazar *s.n.* [Stephenson 601] (FWVA), 8.x.1982 Fred Tawny *s.n.* [Stephenson 603] (FWVA), 10.x.1982 Tom Asher *s.n.* [Stephenson 604] (FWVA).

5. *AMANITA PANTHERINA* var. *VELATIPES* (Atk.) Jenkins (8, 16)

≡*Amanita velatipes* Atk.

This species is medium to large; button specimens can be the size of a child's fist. The pileus is often a tannish or yellowish cream with a more deeply pigmented disc. The annulate, white stipe has a cothurnate basal bulb. The varietal name arises from the fact that Atkinson believed at first that the annulus (which often is pulled up into a funnel shape initially) was composed of material of the stipipellis; this is not the case. Found in mixed forests under hemlock and yellow birch.

SP: [20/1/1] (8.5-) 8.8 - 9.8 (-11.5) × 6.5 - 7.2 (-8.0) μm; **L** = 9.3 μm; **W** = 6.8 μm; Q = (1.25-) 1.31 - 1.43 (-1.44); **Q** = 1.36.

CE: WV—Webster Co. - Cranberry River, 9.vii.1991 Gerald Bills 101 (BPI 900688).

6. *AMANITA PARCIVOLVATA* (Peck) E. J. Gilb. (8, 16)

This scarlet-capped, small to medium mushroom has a strongly striate margin. Crumbs of yellow universal veil material are often to be found on the pileus, but are easily lost. The yellow stipe has a pronounced bulb and lacks an annulus even at the earliest stages of fruiting body expansion. Found in open areas of deciduous or mixed forests that include oaks. The collection examined was found in open, deciduous forest under oak, maple, cherry, and cucumber magnolia (*Magnolia acuminata* L.).

SP: [27/2/1] (9.2-) 9.5 - 11.8 (-12.0) × 6.5 - 7.8 (-8.0) µm; **L** = 10.1 - 10.9 µm; **L'** = 10.7 µm; **W** = 7.0 - 7.3 µm; **W'** = 7.2 µm; **Q** = (1.33-) 1.38 - 1.60 (-1.62); **Q** = 1.45 - 1.50; **Q'** = 1.49.

CE: PA—Westmoreland Co. - *ca.* Vandergrift, Northmoreland Pk., 24.vii.1992 E. Johnson *s.n.* (RET).

7. *AMANITA SPECIES 32* (16)

The pileus of this entity is yellow with a disc that becomes fulvous after collecting. It has an evanescent annulus and a strikingly white, subglobose, ocreate bulb. In the experience of Tulloss (unpub. data), it is always associated with hemlock; and it is one of the first species of *Amanita* to appear in June.

SP: [40/2/2] 7.0 - 8.4 (-9.8) × 6.3 - 8.0 µm; **L** = 7.6 - 7.9 µm; **L'** = 7.8 µm; **W** = 7.1 - 7.3 µm; **W'** = 7.2 µm; Q = 1.0 - 1.14 (-1.27); **Q** = 1.08 - 1.09; **Q'** = 1.09).

CE: PA—Lawrence Co. - McConnells Mill, E. Johnson *s.n.* [Tulloss 6-10-85-EJ1].

a. *AMANITA FROSTIANA* (Peck) Sacc. (7, 16)

This small to medium sized mushroom has an orange pileus with short striations at the margin. The universal veil material is yellow. The bulb is often subocreate. This species has often been confused with *A. flavoconia* of section *Validae*—even in the type collection (Jenkins, 1977). However, the two taxa can be separated easily by the shape of the spores and the fact that the spores of *A. frostiana* are inamyloid while those of *A. flavoconia* (see below) are distinctly amyloid. **SP**: 7.0 - 10.2 × 7.0 - 10.2 µm; **Q** = 1.01.

b. *AMANITA MUSCARIA* var. *ALBA* Peck (12)
=*Amanita chrysoblema* Atk. *in* C. H. Kauffm.

This entity is of the size and form of *A. muscaria* var. *formosa*, but has a white to off-white pileus. The stipe becomes yellowish when handled or wounded. **SP**: 7.9 - 14.1 × 6.3 - 9.4 µm; **Q** = 1.41.

c. *AMANITA PANTHERINA* var. *MULTISQUAMOSA* (Peck) Jenkins (4, 16, 25, 43)

≡*Amanita multisquamosa* Peck

=*Amanita cothurnata* Atk.

This small to medium mushroom has a white to pallid pileus with marked marginal striations; the disc may be tan to brown. The white, annulate stipe has a cothurnate bulb at its base. SP: 8.7 - 11.8 × 6.3 - 8.7 μm; Q = 1.25.

d. *AMANITA RUSSULOIDES* (Peck) Sacc. (13, 16)

=*Amanita gemmata sensu auct. amer. p. p.*

The name *Amanita gemmata* is applied to a number of distinct taxa in North America (*i.e.*, to a "species complex"). *Amanita russuloides* has a yellow to deeply yellow pileus. The white stem has a bulb with something of a point on its base; and the volval material on the stipe is often present as a small limb at the point where the stipe and bulb meet. Volval material on the pileus is in the form of white warts. SP: (8.7-) 9.8 - 10.5 (-10.8) × 6.6 - 7.7 μm; Q = 1.40.

e. *AMANITA SPECIES W2* (16)

A small, bright yellow mushroom with a "*pantherina*-type" bulb. Slides without dried material have been supplied to Tulloss by E. Johnson.

SUBGENUS *Amanita* SECTION *Vaginatae* (Fr.) Quél.

Like the previously discussed section, section *Vaginatae* includes species with a striate pileus margin, usually truncate lamellulae, and inamyloid spores. The stipe of species in this section is totally elongating—all tissue of the stipe participates in the expansion process leaving no bulb at the stipe base. Many species in the section lack an annulus; but there are some species that always exhibit one. For example, *A. jacksonii* and *A. spreta* have persistent, membranous partial veils. Size and form of the universal veil are other important characters. It may be friable and easily broken up into warts as in the many undescribed entities collectively called "*A. inaurata*" or "*A. ceciliae*" in North American literature, or it may be membranous and sheathing on the stipe. In *A. virginiana*, the volva is scant and at times like a small piece of exploded popcorn. *Amanita spreta* has a thimble-like volva. *Amanita jacksonii* has a large, thick, egg-shaped, cottony-surfaced one. Size and form of the stipe's central cylinder are important to record as are pileus color and the ratio of the length of pileus striations to pileus radius. In some taxa there are colored fibrils or scales on an otherwise pallid stipe; note should be made of these.

In North America, this is probably the section of *Amanita* containing the largest number of species. It is also the most poorly understood section of the genus over most of the world. The vast majority of entities in this section are undescribed.

Not yet collected in the region, but to be expected: *A. pachysperma* Atk. has a gray cap, annulate stipe, plentiful 2-spored basidia, a habit like that of *A. virginiana* (below), and a known range extending from North Carolina to Rhode Island (Tulloss, 1993). In addition, there has been reported to us an entity for which we have no voucher specimen; it was described to us as a dark capped, "annulate *vaginata*."

KEY

1. Universal veil friable, never leaving limb at stipe base; stipe exannulate.
  2. Pileus white at first with tan tinge over disc, becoming entirely pale gray at maturity; universal veil as small, white, crumb-like warts, becoming ochraceous and then rather dark brown on exposure; spores (9.5-) 9.8 - 11.5 (-13.0) × (9.0-) 9.2 - 11.0 (-11.5) μm, with Q =1.06............................ *Amanita species W13.*
  2. Pileus deep, slightly reddish brown to brown-bister to brown to pale brown with umbrinous tint to bronzy or yellowish brown.
    3. Pileus deep, slightly reddish brown with universal veil as dark brownish gray to nearly black, irregularly distributed warts; universal veil on stipe as loose brownish gray patch(es) and two dark rings near stipe base separated by a pale, strangulate region; spores (8.2-) 9.0 - 14.0 (-15.5) × (8.0-) 8.5 - 13.5 (-15.0) μm, with Q = 1.05 - 106.. *Amanita species N24.*
    3. Pileus not a deep, slightly reddish brown.
      4. Pileus pallid brown with umbrinous tint; universal veil on pileus as gray to blackish gray warts and patches with pallid edges, on stipe as gray to dark gray patch on lower stipe or as dark narrow ring near stipe base; spores (7.7-) 9.0 - 12.0 (-14.2) × (7.0-) 8.8 - 11.8 (-13.5) μm, with Q = 1.04 - 1.07.. *Amanita species V3.*
      4. Pileus brown-bister to bronzy or yellowish brown with universal veil as dark gray pulverulent patches and warts; spores (Kühner & Romagnesi, 1984) 11.5 - 14 μm in diameter.. *Amanita ceciliae.* [Not confirmed for North America.]
1. Universal veil leaving limb at stipe base (although limb occasionally discoloring and collapsing; stipe exannulate or (occasionally) annulate.
  5. Universal veil submembranous, leaving patches on pileus and/or sac at stipe base, usually discoloring rather quickly to some shade of gray; stipe exannulate.
    6. Pileus deep chocolate or umbrinous brown; spores 8.7 - 10.8 (-11.9) × (7.3-) 8.7 - 9.1 (-10.8) μm, with Q = 1.12...................................... *Amanita species W3.*
    6. Pileus Chinese yellow or olivaceous or the color of curry powder; spores (8.0-) 9.1 - 12.1 (-15.4) × (7.0-) 8.4 - 11.5 (-15.4) μm, with Q = 1.04 - 1.09 (-1.10)... *Amanita sinicoflava.*
  5. Universal veil membranous, leaving patch on pileus or not, never discoloring to a shade of gray; stipe exannulate or not.
    7. Stipe with persistent annulus.
      8. Stipe cream to yellow with yellowish white to yellow annulus and yellowish to orange fibrillose decoration of stipe below annulus; basidiocarp medium to large and of rather slender habit.
        9. Pileus brilliant red or orange-red with yellow margin; stipe with orange,

felted patches or fibrillose scales; universal veil as a large, initially egg-shaped, saccate volva; spores (7.0-) 7.5 - 9.8 (-11.0) × (5.2-) 5.5 - 7.2 (-8.5) μm, with Q = 1.36 - 1.40.. *Amanita jacksonii*.

9. Pileus often yellow at first, later orange-brown with yellow margin; stipe lacking orange patches or scales; universal veil as a white, saccate volva of moderate to small size; spores (7.5-) 8.4 - 11.9 (-15.0) × (5.2-) 5.9 - 7.5 (-9.8) μm, with Q = 1.39 - 1.61 (-1.69).......................... *Amanita species 16*.

8. Stipe not yellow and lacking yellow or orange decoration; basidiocarp small and delicate to medium-sized.

10. Basidiocarp small and delicate.

11. Disk dark brown, margin paler; spores (9.1-) 11.5 - 15.0 (-20.5) × (6.5-) 8.5 - 11.2 (-15.5) μm, with Q = (1.16-) 1.23 - 1.41 (-1.55)...... *Amanita virginiana*.

11. Poorly known; spores (Coker, 1917) 10 - 12 × 7 - 8 μm, with est. Q = 1.45.. *Amanita spreta* var. *parva*.

10. Basidiocarp medium-sized; pileus dirty cream to brownish gray with rather short marginal striations; stature often rather stocky; volval sac rather small for the size of the basidiocarp; spores (Jenkins, 1986) 10.2 - 13.3 × 5.5 - 7.0 μm, with Q = 1.86... *Amanita spreta* var. *spreta*.

7. Stipe exannulate from the first.

12. Pileus pale gray to white or whitish.

13. Basidiocarp small; pileus chalky white; saccate volva rather robust; spore data unknown... *Amanita species W4*.

13. Not as above.

14. Pileus white, volval sac somewhat flimsy; spores (Thiers, 1982) 9.5 - 12.0 × 9.5 - 11.5 μm, with est. Q = 1.0.................................... *Amanita vaginata* var. *alba sensu auct. amer*.

14. Pileus pale grayish to off-white; alpine and subarctic species known from Europe and Greenland; spores (9.5-) 10.0 - 13.5 (-18.0) × (8.0-) 9.0 - 12.0 (-17.2) μm, with Q = 1.07 - 1.16 (-1.18)...................... *Amanita nivalis*.

[Not confirmed for North America.]

12. Pileus some other color or colors.

15. Pileus color a shade of orange or orange-brown or red-brown or olivaceous yellow-brown with brown umbo, not zonate.

16. Pileus orangish tan to orange-brown, may be pale when just expanding out of volval sac; stipe without colored fibrils; volval with ochraceous or orangish stains and spots; lamellae not drying pale orange; spores (8.0-) 9.2 - 12.0 (-14.0) × (6.8-) 8.8 - 11.2 (-12.5) μm, with Q = 1.06 - 1.09 (-1.10)... *Amanita fulva sensu auct. amer*.

16. Pileus brownish orange or orange-brown or clear yellow-orange or red-brown (with umbrinous tints in some regions) or olivaceous yellow-brown with brown umbo; stipe decorated or not.

17. Pileus a clear yellow-orange; stipe usually decorated with concolorous, fibrillose scales; spores (Jenkins, 1986) 9.4 - 11.2 × 8.6 - 10.6 μm, with Q = 1.05 .... *Amanita crocea sensu auct. amer.*

17. Pileus brownish orange or orange-brown to red-brown (with umbrinous tints in some regions) or olivaceous yellow-brown with brown umbo.

18. Pileus red-brown to umbrinous, darkest at disc, paler at margin; stipe pale grayish brown with dark fibrils; basidiocarp medium to large (pileus usually > 75 mm wide); volval sac white and quite large and thick; spores 10.5 - 12.2 (-12.9) × (8.4-) 9.8 - 11.9 μm, with Q = 1.06 .... *Amanita species W8.*

18. Pileus brownish orange or orange-brown or olivaceous yellow-brown with brown umbo, usually < 75 mm wide.

19. Pileus olivaceous yellow-brown with brown umbo; spores (11.2-) 11.5 - 14.0 × (10.5-) 10.8 - 12.5 μm, with Q = 1.11 ...... *Amanita species W14.*

19. Pileus brownish orange; stipe with pale orangish white tints, undecorated, graying from handling; volval sac soon getting brown or rusty brown spots or stains, of size and form of that of *A. fulva sensu auct. amer.*; lamellae drying pale pinkish orange; spores (8.2-) 9.0 - 11.0 (-12.0) × (7.2-) 8.0 - 9.5 (-11.2) μm, with Q = 1.10 - 1.14 .... *Amanita species W10.*

15. Pileus zonate or a shade of gray or brownish gray; basidiocarps of varying size.

20. Pileus a shade of gray or brownish gray, not zonate; basidiocarp small to medium-sized.

21. Spores ellipsoid, (9.4-) 10.5 - 12.2 × 7.0 - 8.7 μm, with Q = 1.44 .... *Amanita species W7.*

21. Spores globose to subglobose,

22. Pileus pale gray-brown; lamellae white and drying without pinkish or lavender tint; basidia dominantly 4-sterigmate; spores (7.8-) 9.2 - 12.5 (-15.8) × (7.2-) 8.7 - 12.0 (-14.2) μm, with Q = 1.04 - 1.07 .... *Amanita vaginata sensu lato.*

22. Basidiocarp entirely very pale gray including lamellae; dried gills with a pale grayish pink or lavender tint; basidia 1- or 2-sterigmate; spores (10.1-) 10.5 - 12.2 (-15.4) × 9.4 - 11.5 (-13.3) μm, with Q = 1.10 .... *Amanita species W9.*

20. Pileus zonate, umbrinous brown to pale umbrinous brown; basidiocarp not large (pileus usually < 75 mm wide); spores (10.0-)

10.2 - 13.2 (-13.8) × (9.2-) 9.5 - 12.5 (-13.2) μm, with **Q** = 1.05 - 1.06.. *Amanita species N40.*

8. *AMANITA FULVA sensu auct. amer.* (8, 16, 24, 41, 42, 43)

This is a very common mushroom in the northeastern part of the United States. It has an orangish tan to orangish brown pileus with a striate margin. There is rarely any remnant of the universal veil left on the pileus. The stipe is white to pallid and exannulate and has a membranous, whitish, rusty-stained volval sac at its base. The rusty stains on the volval sac, the color of the pileus, and the spore size and shape are considered to be diagnostic. A complete comparison of anatomy between the North American material and European material has not yet been made. However, Tulloss (unpub. data) has found they differ in the anatomy of the lamella trama and in the size of the spores. This species is found in many forest types; the WV collections reviewed occurred in mixed forests containing pines, hemlock, and striped maple (*Acer pensylvanicum* L.) and in forests dominated by yellow birch, hemlock, red oak, and basswood. The species tolerates wet soil and may be found growing in very rotten stumps. Bills *et al.* (1986) reported the species as occurring both in red spruce and northern hardwood forests.

SP: [120/6/6] (8.0-) 9.2 - 12.0 (-14.0) × (6.8-) 8.5 - 11.5 (-12.5) μm; **L** = 10.0 - 10.9 μm; **L'** = 10.6 μm; **W** = 9.2 - 10.1 μm; **W'** = 9.8 μm; Q = (1.0-) 1.03 - 1.12 (-1.22); **Q** = 1.07 - 1.09; **Q'** = 1.08.

CE: WV—Greenbrier Co. - woods above rest stop along U.S. Rt. 60 *ca.* 1 mile W of Charmco, 9.viii.1990 Michael A. Vincent 4388 (MU F38504). Pocahontas Co. - Black Mtn., 31.vii.1982 G. Bills 421 (BPI 900737); Monongahela Nat. For., 26.vii.1977 K. H. & Kathleen McKnight *s.n.* (BPI 14713). Randolph Co. - Gaudineer Scenic Area, 26.ix.1992 S. L. Stephenson, R. P. Bhatt & A. Kumar A4 (FWVA; RBHATT). Tucker Co. - Abe Run Tr., Canaan Valley St. Pk., Mary A. King & Estelle H., J. Carroll, Sarah E. K. & R. E. Tulloss 8-6-92-A, R. E. Tulloss 8-6-92-B.

9. *AMANITA JACKSONII* Pomerleau (11, 16, 24, 25, 43)

≡*Amanita umbonata* Pomerleau [*non* (Sumst.) Sacc. & Trott.]
=*Amanita caesarea sensu auct. amer.* [*non* (Scop.:Fr.) Pers.]

This unmistakable fungus has a brilliant red or orange red pileus with a pronounced umbo and a long-striate margin that may become yellow during expansion. The lamellae, annulus, and stipe are yellow. A felted orange material is located between the annulus and the stipe during development of the button; this breaks up into small patches and scales as the stipe expands. The volva is large, thick, white, and saccate.

SP: [40/2/1] (7.0-) 7.5 - 9.5 (-10.8) × 5.2 - 6.8 μm; **L** = 8.1 - 8.8 μm; **L'** = 8.4 μm; **W** = 6.0 - 6.3 μm; **W'** = 6.1 μm; Q = (1.14-) 1.25 - 1.55 (-1.59); **Q** = 1.37 - 1.40; **Q'** = 1.38.

CE: WV—Pocahontas Co. - Monongahela Nat. For., 28.viii.1977 S. L. Stephenson 215 (FWVA).

10. *AMANITA SINICOFLAVA* Tulloss (16, 26)

This mushroom has an olive-tan to curry-yellow pileus and a stipe that often has dark fibrils over a pallid ground color; its universal veil forms a sac that becomes gray and somewhat fragile with age and is more nearly membranous than that of *A. ceciliae sensu auct. amer.* (including *A. species N24* and *A. species V3*), but less robust than that of *A. fulva sensu auct. amer.*

SP: [60/3/1] (9.1-) 9.8 - 12.2 (-12.6) × (8.7-) 9.1 - 11.2 (12.2) μm; **L** = 10.7 - 11.1 μm; **L'** = 10.9 μm; **W** = 10.2 - 10.4 μm; **W'** = 10.4 μm; Q = 1.0 - 1.11 (-1.15); **Q** = 1.05 - 1.07; **Q'** = 1.06.

CE: VA—Grayson Co. - Grayson Highlands St. Pk., Cabin Creek Tr., 9.ix.1986 Robert S. Williams 323 (paratype, RET).

11. *AMANITA VAGINATA* (Bull.:Fr.) Lamarck *sensu lato* (11, 16, 24, 25, 41, 42, 43)

This is a species in need of clarification. The present understanding of this entity is that it has a grayish to gray-brown pileus; a strongly striate pileus margin; an exannulate, pallid stipe; globose spores; and a sheathing, whitish, unstaining volval sac. The caps of West Virginia collections varied from pale gray-brown to brownish gray, sometimes the disc was darker than the rest of the cap. Bills *et al.* (1986) describe this entity as occurring in northern hardwood forests. Our Tucker Co. collections were from deciduous forests containing beech and maples and from mixed forests containing hemlock, birch, maple, black cherry, red spruce, and hornbeam [*Ostrya virginiana* (Mill.) K. Koch].

SP: [140/7/5] (7.8-) 9.2 - 12.5 (-15.8) × (7.2-) 8.8 - 12.0 (-14.2) μm; **L** = 10.0 - 11.3 μm; **L'** = 10.8 μm; **W** = 9.4 - 10.8 μm; **W'** = 10.2 μm; Q = 1.0 - 1.11 (-1.20); **Q** = 1.04 - 1.07; **Q'** = 1.05.

CE: WV—Tucker Co. - Blackwater Falls St. Pk., Mozark Mtn., Lindy Run, David T. Jenkins *s.n.* [Tulloss 8-2-85-E]; *ca.* Canaan Valley St. Pk., 2.ix.1985 R. Phillips 2938; Canaan Valley St. Pk., Deer Run Tr., R. E. Tulloss 8-3-92-B; Fernow Exp. For., 21.ix.1992 S. L. Stephenson WS4-5 (FWVA), 4.ix.1992 S. L. Stephenson, R. P. Bhatt & A. Kumar WS13-109 (FWVA).

12. *AMANITA VIRGINIANA* (Murr.) Murr. (6, 38, 43)

Amanita virginiana is a very small mushroom that has a brown or brownish pileus with a pallid region near the plicate margin and (occasionally) a few small patches of the membranous universal veil. The stipe bears a superior to submedian white, very small annulus and a small volval sac that looks like a fragmented cup—sometimes appearing as if the expansion of the fruiting body had blown it apart like a piece of popcorn exploding. Because it is so small, the species can be found in lawns even after they have been mowed. This mushroom has rather large, broadly ellipsoid to ellipsoid spores; and the majority of the basidia are 2-spored. The type of this species was collected in southwestern Virginia. It is sometimes associated with red oak.

SP: [140/7/1] (9.2-) 12.0 - 15.8 (-20.5) × (7.2-) 8.8 - 11.5 (-15.5) μm; **L** = 13.2 - 14.0 μm; **L'** = 13.8 μm; **W** = 9.7 - 10.4 μm; **W'** = 10.1 μm; Q = (1.12-) 1.23 - 1.50 (-1.62); **Q** = 1.29 - 1.40; **Q'** = 1.36.

CE: VA—Giles Co. - *ca.* Mountain Lk., 8-14.vii.1909 W. A. Murrill 28 (holotype, NY; isotype, NCU).

13. *AMANITA SPECIES 16* (16, 18)

This fungus has a yellow-orange to yellow-bronze cap (often developing a brown to orange-brown umbo), yellow lamellae, yellow to cream stipe, and pale yellow annulus. It appears like a "small *jacksonii*," but with a differently colored pileus, a proportionately smaller volval sac, and without the orange-red fibrils on the stipe. *Amanita arkansana* Rosen has white lamellae, spores with **Q** = 1.22 - 1.30 (-1.33) (Tulloss, unpub. data), and is larger. Mary Banning, writing in 1888 (Peck, 1892), apparently recognized this entity as an occasional form of "*caesarea*": "Sometimes the pileus is . . . burnt sienna color with yellowish margin. It varies also in size." During his time in West Virginia, Beardslee's notes (MICH) indicate that he distinguished this entity from the red American caesar's mushroom (*A. jacksonii*) and thought that *A. species 16* was the more plentiful of the two taxa in West Virginia. Occurs under hardwoods such as in mixed forests of oaks, beech, and hickories.

SP: [119/6/4] (7.5-) 8.4 - 12.8 (-15.0) × (5.2-) 6.0 - 8.0 (-9.8) μm; **L** = 9.1 - 10.4 (-11.5) μm; **L'** = 10.1 μm; **W** = 6.3 - 6.8 (-7.5) μm; **W'** = 6.7 μm; Q = (1.20-) 1.31 - 1.94 (-2.14); **Q** = 1.44 - 1.48 (-1.69); **Q'** = 1.49.

CE: WV—Berkeley Co. - Hedgeville, "Sleepy Hollow," 1.viii.1976 U. Weiss *s.n.* (BPI 14459). Greenbrier Co. - Greenbrier St. For., 26.viii.1980 S. L. Stephenson 187c (FWVA); Monongahela Nat. For., Lk. Sherwood, R. E. Tulloss 8-31-82-C. Tucker Co. - Fernow Exp. For., Fork Mtn. Rd., 19.ix.1992 R. P. Bhatt & A. Kumar FMR-3 (FWVA).

14. *AMANITA SPECIES N24* (16)

=*Amanita ceciliae sensu auct. amer. p.p.*

This beautiful species has a deep, slightly reddish brown cap with its pigment sometimes in radial streaks. The stipe has a pallid ground color and is densely covered with brown fibrils. The volva may be absent from the pileus or appear as very dark to nearly black warts. On the stipe, the volva forms two brownish gray rings near the very base. The rings are separated by a pallid, strangulate zone. Patches of volval material may appear on the lower stipe above the two rings.

SP: [40/2/1] (8.2-) 9.0 - 14.0 (-15.5) × (8.0-) 8.5 - 13.5 (-15.0) μm; **L** = 10.4 - 12.5 μm; **L'** = 11.4 μm; **W** = 9.9 - 11.9 μm; **W'** = 10.9 μm; Q = (1.0-) 1.02 - 1.10 (-1.22); **Q** = 1.05 - 1.06; **Q'** = 1.05.

CE: WV—Tucker Co. - McGowan Mtn. Rd., 19.ix.1992 R. P. Bhatt & A. Kumar FMR-3A (FWVA).

15. *AMANITA SPECIES N40* (16)

Cap umbrinous brown to pale umbrinous brown, often with a darker ring at the inner ends of the marginal striations; stipe pallid, exannulate; universal veil adnate to stipe for about one-third of volva's height, rather copious at first and having rather large internal limb. Found in mixed deciduous forests containing maple, yellow birch, and beech.

SP: [20/1/1] 10.0 - 11.5 × 9.2 - 11.0 μm; **L** = 10.7 μm; **W** = 10.1 μm; Q = 1.02 - 1.11; **Q** = 1.06.

CE: WV—Tucker Co. - Canaan Valley St. Pk., Deer Run Tr., R. E. Tulloss 8-3-92-E.

16. *AMANITA SPECIES V3* (16)

=*Amanita ceciliae sensu auct. amer. p.p.*

This mushroom has a broadly campanulate, pallid brown pileus with umbrinous tint. The pileus margin is striate up to about 40% of its radius. On the pileus, the universal veil warts and small patches are gray to blackish gray with pallid edges. The stipe is exannulate and whitish; and pale gray to gray universal veil patches are easily left in the soil when the mushroom is collected. Found in mixed forests containing white oak, white pine, Virginia pine, and scrub pine or in hardwood forests containing oaks or in old growth spruce forests containing yellow birch (up to at least 1220 m elev.).

SP: [60/3/3] (7.7-) 9.0 - 12.0 (-14.2) × (7.0-) 8.8 - 11.8 (-13.5) μm; **L** = 10.0 - 11.0 μm; **L'** = 10.5 μm; **W** = 9.3 - 10.5 μm; **W'** = 10.0 μm; Q = 1.0 - 1.11 (-1.12); **Q** = 1.04 - 1.07; **Q'** = 1.06.

CE: VA— Bath Co. - Douthat St. Pk., R. E. Tulloss 6-16-92-A. WV—Berkeley Co. - Hedgeville, "Sleepy Hollow," 1.viii.1976 U. Weiss *s.n.* (BPI 14460B); Marion Co. - Mill Fall Run, 5.x.1993 S. L. Stephenson & D. Binion [Stephenson 93-04] (FWVA) [immature, sporulation not begun]. Randolph Co. - Gaudineer Scenic Area, 26.ix.1992 R. P. Bhatt, S. L. Stephenson & A. Kumar A6 (FWVA).

17. *AMANITA SPECIES W3* (16)

This mushroom has a dark chocolate pileus, occasionally nearly completely covered with a membranous patch composed of almost all of the graying universal veil, and bisterigmate basidia. Found in mixed forests containing hemlock, oaks, and birch with or without maple, red spruce, rhododendrons, or alder/sphagnum bogs nearby.

SP: [15/1/1] 8.7 - 10.8 (-11.9) × (7.3-) 8.7 - 9.1 (-10.8) μm; **L** = 10.0 μm; **W** = 8.9 μm; Q = 1.03 - 1.20 (-1.23); **Q** = 1.12.

CE: WV—Randolph Co. - Monongahela Nat. For., Otter Creek Wilderness, 2.viii.1985 P. Musgrove *s.n.* [Tulloss 8-2-85-C]. Tucker Co. - Canaan Valley St. Pk., 2.viii.1985 D. C. Tulloss *s.n.* [R. E. Tulloss 8-2-85-F] [no mature basidia].

18. *AMANITA SPECIES W4* (16)

This chalky white mushroom is small and has a more robust volva than *A. vaginata* var. *alba sensu auct. amer.*

SP: Unknown.

CE: WV—Tucker Co. - Lindy Run S of Blackwater Falls St. Pk., 2.viii.1985 D. T. Jenkins *s.n.* [Tulloss 8-2-85-G] [no mature basidia].

19. *AMANITA SPECIES W7* (16)

This mushroom is small and has a grayish-buff pileus. The spores have a high Q value for a species of section *Vaginatae* with exannulate stipe. Found in mixed hardwood forests containing oak and hickory.

SP: [20/1/1] (9.4-) 10.5 - 12.2 × 7.0 - 8.7 μm; **L** = 11.2 μm; **W** = 8.2 μm; Q = (1.24-) 1.26 - 1.60 (-1.63); **Q** = 1.44.

CE: WV—Tucker Co. - Canaan St. Pk., 2.ix.1985 R. Phillips 2935.

20. *AMANITA SPECIES W8* (16)

A large mushroom with a large, thick, white, buried volva, this entity has a red-brown to dark umbrinous pileus (disc may be darker and margin paler). The exannulate stipe is grayish brown with fibrils that are dark from the outset or darken from handling. Found in mixed deciduous forests containing hemlock and beech with an understory of rhododendron.

SP: [20/1/1] 10.5 - 12.2 (-12.9) × (8.4-) 9.8 - 11.9 μm; **L** = 11.5 μm; **W** = 10.8 μm; Q = (1.0-) 1.03 - 1.08 (-1.28); **Q** = 1.06.

CE: WV—Tucker Co. - Canaan St. Pk., 2.viii.1985 R. S. Williams *s.n.* [Tulloss 8-2-85-D] [no mature basidia]; Horseshoe Run, D. C. & R. E. Tulloss 8-3-85-D.

21. *AMANITA SPECIES W9* (16)

This is a medium-sized mushroom, very pale gray all over including the lamellae. The dried lamellae have a pale grayish pink or lavender tint [about 10-12B2 in (Kornerup and Wanscher, 1978)]. The exannulate stipe has a base that is enclosed in a white, saccate volva. The basidia are about equally 1-spored and 2-spored.

SP: [20/1/1] (10.1-) 10.5 - 12.2 (-15.4) × 9.4 - 11.5 (-13.3) μm; **L** = 11.6 μm; **W** = 10.5 μm; Q = (1.0-) 1.06 - 1.17 (-1.24); **Q** = 1.10.

CE: WV—Preston Co. - Terra Alta, 7.ix.1986 W. Sturgeon *s.n.* [Tulloss 9-7-86-WS1].

22. *AMANITA SPECIES W10* (16)

This mushroom has an orange-brown pileus (a little more orange than *A. fulva sensu auct. amer.*) and lamellae that dry a beautiful pale pinkish orange. Found in mixed forests of white pine and species of oak—including white oak and post oak.

SP: No mature basidia on specimen from region of study.

CE: KY—Laurel Co. - Levi Jackson Wilderness Trail St. Pk., D. C. & R. E. Tulloss 7-20-87-A.

23. *AMANITA SPECIES W13* (16)

This mushroom has a pileus that is white at first and slowly becomes a pale tan over the disc and finally becomes a pale gray. The white stipe is exannulate and bruises slightly yellowish tan from handling. The universal veil material on the pileus and the stipe base is in small warts that are white at first and then become ochraceous and, finally, brown. Found in deciduous forests containing oaks.

SP: [40/1/1] (9.5-) 9.8 - 11.5 (-13.0) × (9.0-) 9.2 - 11.0 (-11.5) μm; **L** = 10.7 μm; **W** = 10.1 μm; Q = (1.02-) 1.03 - 1.10 (-1.16); **Q** = 1.06.

CE: WV—Marion Co. - Mill Fall Run, 26.ix.1992 R. P. Bhatt, A. Kumar & R. E. Tulloss [Bhatt A5; Tulloss 9-26-92-A] (FWVA; RET).

24. *AMANITA SPECIES W14* (16)

This entity has an olivaceous yellow-brown pileus with a brown umbo; a copious, white volval sac; and a gray stipe with a delicate chevron-like pattern of fibrils. Found in mixed deciduous forests containing beech, yellow birch, maples, and other hardwoods.

SP: [20/1/1] (11.2-) 11.5 - 14.0 × (10.5-) 10.8 - 12.5 μm; **L** = 12.9 μm; **W** = 11.6 μm; Q = (1.03-) 1.07 - 1.17; **Q** = 1.11.

CE: WV—Tucker Co. - Canaan Valley St. Pk., Deer Run Tr., R. E. Tulloss 8-3-92-F.

f. *AMANITA VAGINATA* var. *ALBA sensu auct. amer.* (16)

This mushroom is entirely white with an exannulate stipe and an easily torn, sheathing volval sac. There are usually no remnants of the universal veil left on the pileus. The European entity claimed for North America was originally published by Gillet with a minimal description, and there is apparently no valid name for the taxon at the species rank. *Amanita alba* Pers. represents the earliest use of the specific epithet "*alba*" in *Amanita* (Bas, 1969) and is assignable to section *Amidella*. **SP**: 9.5 - 12.0 × 9.5 - 11.5 μm; **Q** = approx. 1.10.

g. *AMANITA CECILIAE sensu auct. amer.* (7, 11, 16, 25, 41, 42, 43)

This name is applied to many different, undescribed taxa in North America. Most frequently it is applied to taxa with a brownish pileus and a friable universal veil that is white at first, but becomes gray to blackish gray. The stipe is exannulate and has a proportionately large hollow cylinder in its center. The true *A. ceciliae* is an European entity with larger spores. Bills *et al.* (1986) report an entity under this name from both red spruce and northern hardwood forests. See *Amanita species V3* and *Amanita species N24*, above. **SP**: 10.2 - 11.7 × 10.2 - 11.7 μm; **Q** = 1.0.

h. *AMANITA CROCEA sensu auct. amer.* (8)

This distinctive species was described from Europe, but is claimed as present in the U.S. by several authors. The pileus is orange to yellowish orange; the stipe is exannulate and has a dense coating of upward pointing fibrillose scales that are concolorous with the pileus. The habit is that of *A. fulva*. **SP**: 9.4 - 11.2 × 8.6 - 10.6 μm; **Q** = 1.05.

i. *AMANITA NIVALIS* Grev. (11, 12)

This is a small mushroom with an off-white to pale grayish or pale brownish-gray pileus. The pallid stipe is exannulate; and the volva is membranous and saccate. Reference to collections of this species in North America are questionable since this entity (described from Scotland) is restricted to alpine and subarctic regions in association with dwarf or scrub willows (*Salix spp.*) according to Watling (1985). In the past this name may have been misapplied to *A. alba sensu auct. amer.* **SP**: (9.5-) 10.2 - 13.5 (-18.0) × (8.0-) 9.2 - 12.2 (-17.2) μm; **Q** = 1.08 - 1.14 (-1.18).

j. *AMANITA SPRETA* (Peck) Sacc. var. *SPRETA* (11, 25, 43)

This is a medium to rather large mushroom with a hemispheric, brownish pileus that has quite short marginal striations. The stipe has a small, membranous, superior annulus; and the volva is white and membranous and disproportionately small for the size of the stipe. Millspaugh (1913) mentions a "white form." **SP**: 10.2 - 13.3 × 5.5 - 7.0 μm; **Q** = 1.86.

k. *AMANITA SPRETA* var. *PARVA* Beardslee (11)

The original description of this taxon is so brief as to be inadequate. No type has been located (Tulloss, 1993). No notes on *A. spreta* var. *parva* survive among Beardslee's files in MICH (Tulloss, 1993). Millspaugh (1913) includes notes by Beardslee to the effect that Peck and Bresadola both felt that it should be considered a separate species. "*Amanita spreta* var. *minor*" was introduced as a typographical error by Singer (1951). In the protologue, the spores are described as "as in A. spreta (sic)." **SP** [*per* Coker (1917)]: "elliptic, 6.7-8.2 × 10-12.6 μ."

SUBGENUS *Lepidella* (E. J. Gilb.) Veselý *emend.* Corner & Bas SECTION *Lepidella*

Subgenus *Lepidella* is defined by the presence of amyloid spores. This is often, but not always, accompanied by a nonstriate pileus margin and attenuate lamellulae. The most obvious group of exceptions in North America is to be found in section *Amidella*. Species in section *Lepidella* are often pallid to white or a pale shade of gray or brown. A number of these species have strong odors. The margin of the cap in these species is nonstriate and appendiculate. Some species in the section have fully elongating stipes, although most have a bulb. If there is a volval limb on the upper bulb, it may be membranous, but not thick or leathery. If the volva contains the base of a fully elongating stipe, then the species should be sought in section *Amidella*.

Bas (1969) wrote the definitive work on this section—describing all species known in the world at that time. His monograph is the model for later work on the genus and is indispensable when it comes to serious study of *Amanita*.

In our studies we came across an occasional mention of "*A. solitaria*" as occurring in West Virginia. This is a European taxon that almost certainly does not occur in North America. For this reason, we have omitted it from this paper.

Not yet collected in the region, but to be expected: *A. microlepis* Bas is known from both the mountains of western South Carolina and from central New Jersey. This species has sordid café-au-lait lamellae as does *A. pelioma*; however, *A. micro-*

lepis does not show blue-green staining in any part and has fine, pyramidal warts on both the pileus and the top of its stipe's basal bulb as well as a persistent annulus.

KEY

1. Remains of universal veil on pileus distinctly colored (brown, brownish gray, gray, gray-brown, olive-gray (sometimes with blue-green tint), pinkish, salmon).
  2. Bulb at stipe base bearing concentric rings of warts or recurved scales on its upper surface.
    3. Fruiting body small to medium, pileus 30 - 75 mm wide, dull white to pale gray with dark gray to brownish-gray, pyramidal warts; partial veil soon falling away; lamellae rapidly senescent and slightly yellowing; basal bulb rooting to deeply rooting and having recurved scales on its upper portion; spores (7.0-) 7.6 - 11.0 (-13.0) × (5.0-) 5.5 - 7.0 (-7.7) μm, with Q = 1.36 - 1.65 (-1.84).. *Amanita onusta*.
    3. Fruiting body medium to large, pileus 60 - 180 mm wide; differing in one or more additional characters.
      4. Pileus 60 - 130 mm wide, whitish to pale brownish, with many small, brownish, pyramidal warts; partial veil often persistent, becoming yellowish and slimy with age; rooting bulb encircled for much of its length with concentric rings of brown, subrectangular warts; spores (Bas, 1969) 9 - 10.5 (-12.5) × 5.5 - 7 (-8) μm, with Q = 1.45 - 1.7........................ *Amanita atkinsoniana*.
      4. Pileus 80 - 180 mm wide, dull whitish to pale gray, with universal veil remnants as pulverulent to subfelted, rather dark brownish gray, low, irregular warts or patches; partial veil fragile, soon falling away; bulb at stipe base rooting, fusiform to clavate, with upper portion decorated with rings of concentric rectangular scales (sometimes suggesting a brick wall); spores (Bas, 1969) 9 - 12.5 (-14) × 5.5 - 6.5 (-7) μm, with Q = 1.65 - 1.9.. *Amanita cinereopannosa*.
  2. Bulb at stipe base lacking rings of warts or recurved scales.
    5. Universal veil on pileus pinkish to salmon, having very variable form (needle-like warts touching at tips [like decoration on some species of *Lycoperdon*] to broad and cake-like patches); pileus white to cream; bulb large to very large, turnip- to carrot-shaped, and often bruising salmon to reddish; spores (Bas, 1969) (8.5-) 9 - 11 (-11.5) × (5-) 5.5 - 6.5 (-7) μm, with Q = 1.5 - 1.8.. *Amanita daucipes*.
    5. Universal veil not pinkish to salmon; also differing in one or more additional characters from above.
      6. Pileus 30 - 75 mm wide, whitish to brownish gray, with margin often densely appendiculate; universal veil on pileus as brownish gray, pulverulent layer; all parts lacking blue-green stains; spores (Bas, 1969) 8.5 -

11.5 (-12.5) × (4.5-) 5 - 6.5 μm, with **Q** = 1.7 - 1.9........................ *Amanita cinereoconia* var. *cinereoconia*.

6. Pileus 50 - 90 mm wide, olive gray to brownish gray to whitish, with floccose remnants of universal veil concolorous or tinged blue-green; stipe with characteristic blue-green stain on lower portion and upper part of basal bulb; spores (8.8-) 9.8 - 13.6 (-15.0) × (5.5-) 6.0 - 9.1 (-10.1) μm, with **Q** = 1.49 - 1.76.. *Amanita pelioma*.

1. Remains of universal veil on pileus not strongly colored (cream, off-white, white or white with tints of brown appearing with age).

7. Surface of stipe decorated with distinctive, orangish fibrils especially in lower half and becoming pinkish golden on handling; pileus 70 - 120 mm wide, grayish-brown, becoming whitish toward margin; universal veil on pileus in form of pyramidal to irregular, cream to whitish warts; partial veil thick, but fragile; basal bulb of stipe subglobose to ovoid; (6.5-) 7.0 - 10.8 (-11.2) × 4.5 - 5.8 (-6.2), with **Q** = 1.65 - 1.69.. *Amanita canescens*.

7. Lacking orangish fibrils on the stipe surface; stipe not becoming pinkish golden on handling; also differing in one or more of above characters.

8. Stipe having an abrupt basal bulb that is rounded or pointed below; universal veil on the pileus as pyramidal, often distinctly pointed, white warts; underside of persistent partial veil often connected to stipe by many fibrils (suggesting a cortina); spores (Bas, 1969) 7 - 9.5 × 6 - 8.5 μm, with **Q** = 1.1 - 1.35... *Amanita abrupta*.

8. Differing from the above in one or more characters.

9. Upper portion of basal bulb decorated with many concentric rows of fine warts; entire fruiting body whitish and often rather large; pileus approaching dinner plate size and densely covered with pyramidal warts; spores (Bas, 1969) (9.5-) 10 - 13 × (5.5-) 6.5 - 8 (-9) μm, with **Q** = 1.6 - 1.75.. *Amanita polypyramis*.

9. Lacking concentric rings of fine warts on bulb; differing in one or more other characters from above.

10. Basal bulb decorated by recurved scales, radicating; partial veil membranous, persistent, often double, usually with cortina-like fibrils connecting its underside to the stipe.

11. Odorless when fresh; spores (9.2-) 10.8 - 13.2 (-15.0) × (5.5-) 6.5 - 8.7 (-9.5) μm, with **Q** = 1.44 - 1.56 (-1.74)............................... *Amanita cokeri*.

11. With strong odor like a combination of burnt sugar and cedar wood or a skunk; spores (8.0-) 10.1 - 14.0 (-18.9) × (5.2-) 5.9 - 7.3 (-9.1) μm, with **Q** = 1.59 - 1.95 (-2.02)... *Amanita species 5*.

10. Basal bulb usually smooth, sometimes irregular, lacking recurved scales, partial veil soon falling away.

12. Pileus with large, coarse, conic to truncate-conic, radially fibrillose warts of universal veil material especially in center; basal bulb large, ovoid to turnip- to carrot-shaped or sometimes rather irregular; spores (7.0-) 8.0 - 11.9 (14.0) × (4.9-) 5.2 - 7.7 (-8.0) μm, with Q = 1.49 - 1.64 (-1.81)... *Amanita ravenelii.*

12. Universal veil on pileus as floccose layer or floccose warts, with such warts not radially striate; basal bulb never irregular, usually slender, sometimes top-shaped.

13. Basal bulb of stipe very deeply radicating so that it is rarely collected in its entirety; partial veil sometimes yellowing at touch; spores (7.0-) 8.4 - 11.5 (-14.0) × (4.5-) 4.9 - 6.2 (-7.8) μm, with Q = 1.66 - 1.80 (-1.97)... *Amanita species 9.*

13. Basal bulb rooting, but almost always collectible in its entirety given moderate care; partial veil never yellowing; spores often having different range of widths.

14. Basal bulb large and top-shaped; spores (7.3-) 8.2 - 11.5 (-14.5) × (5.0-) 5.6 - 7.8 (-9.0) μm, with Q = 1.42 - 1.58.................. *Amanita rhopalopus* f. *turbinata.*

14. Basal bulb ovoid to ventricose to elongate.

15. Basal bulb not elongate, usually not doglegged; clamps plentiful at bases of basidia; universal veil on pileus comprised of small inflated cells with few or no hyphae; odor of "chloride of lime"; spores (7.5-) 8.0 - 11.2 (-12.2) × (4.5-) 4.8 - 6.5 (-7.5) μm, with Q = 1.52 - 1.81.. *Amanita chlorinosma.*

15. Basal bulb may be elongate, almost always doglegged; clamps present or absent; universal veil with occasional to plentiful hyphae; with or without strong odor.

16. Basal bulb ovoid to ventricose; clamps absent at bases of basidia; odorless or with slight odor of a tide pool or the seashore; spores (7.8-) 9.8 - 14.0 (-21) × (3.9-) 4.9 - 6.3 (-9.8) μm, with Q = (1.85-) 1.94 - 2.48 (-2.51).............................. *Amanita longipes.*

16. Basal bulb elongate; clamps present at bases of basidia; odor strong and pungent; spores (8.0-) 8.5 - 10.5 (-12.5) × (5.2-) 5.6 - 6.8 (-7.8) μm, with Q = 1.46 - 1.56.............................. *Amanita rhopalopus* f. *rhopalopus.*

25. *AMANITA ABRUPTA* Peck (16, 18, 43)

An abrupt bulb with white pseudorhizae and some fine, concentric rings of volval material on its upper surface gives this species its name. The entire fruiting body is white; the cap, when fresh, is covered with spike-like warts and has an appendiculate margin. The stipe has a large membranous annulus with a thickened margin; the underside of this annulus is connected by many fibers to the stipe. The relatively small, broadly ellipsoid spores distinguish this entity from any remotely similar mushrooms from the region of study. Japanese material assigned to this species has caused a fatal poisoning (Hatanaka, 1992).

SP: [17/1/1] 6.8 - 9.2 (-10.2) × 6.0 - 7.2 (-9.2) μm; **L** = 7.9 μm; **W** = 6.8 μm; Q = 1.07 - 1.26 (-1.31); **Q** = 1.17.

CE: VA—Augusta Co. - Geo. Washington Nat. For., Todd Lk., 28.viii.1982 D. C. Tulloss *s.n.* [Tulloss 8-28-82-A].

26. *AMANITA ATKINSONIANA* Coker (16, 25)

This medium to large sized mushroom has a whitish to pale brownish pileus with many small brownish pyramidal warts. The brown volval material also forms many small warts that encircle much of the surface of the rooting bulb in several concentric rings. The stipe sometimes loses its annulus rather early in development. When the annulus persists on the stipe, it becomes yellowish and slimy with age.

SP: [30/1/1] (8.0-) 8.7 - 10.5 × 5.9 - 7.7 μm; **L** = 9.3 μm; **W** = 6.6 μm; Q = (1.18-) 1.27 - 1.60 (-1.66); **Q** = 1.41.

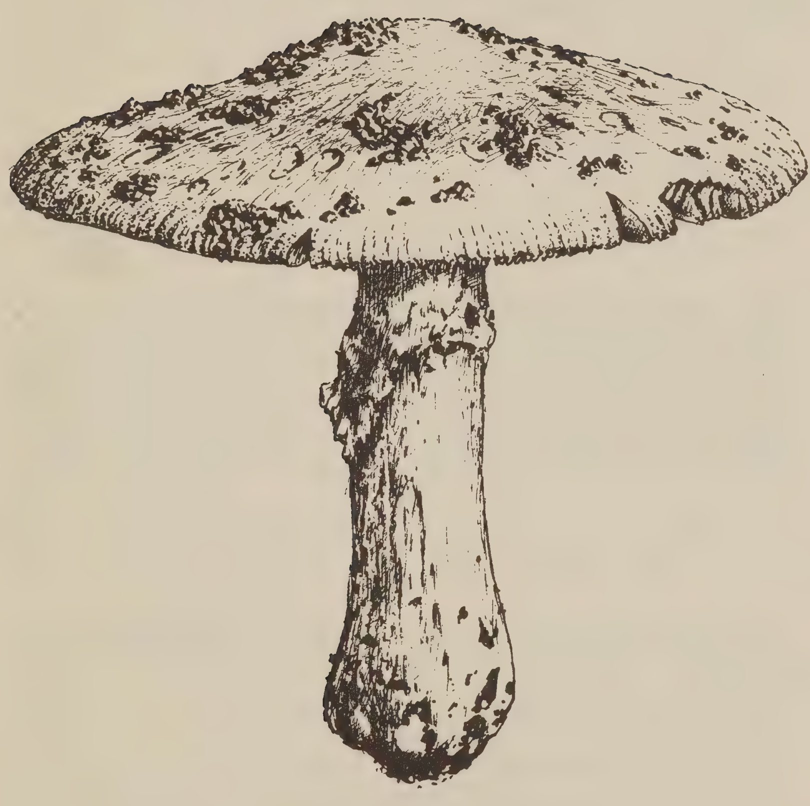
CE: WV—Greenbrier Co. - Monongahela Nat. For., Lk. Sherwood, R. E. Tulloss 8-31-82-D. Tucker Co. - Dolly Sods, 1.viii.1985 W. Sturgeon *s.n.* [Tulloss 8-1-85-B] [immature, sporulation just beginning].

27. *AMANITA CANESCENS* Jenkins

This medium-sized amanita (Fig. 1) has an annulate stipe with a subglobose to ovoid bulb that may be rather minimal. The annulus is thick, delicate, and rather easily lost. The surface of the stipe is decorated with distinctive, orangish fibrils especially in the lower half; and the stipe becomes pinkish golden on handling. The pileus is grayish brown, becoming whitish toward the margin; the universal veil on the pileus is in the form of pyramidal to irregular, cream to whitish warts. The species was originally described from Alabama and was collected in New Jersey by Tulloss in 1993. The West Virginia specimen of this species was found in a mixed hardwood forest containing a high percentage of oaks.

SP: [25/1/1] (6.5-) 7.0 - 10.5 (-10.8) × 4.5 - 5.5 (-6.2) μm; **L** = 8.3 μm; **W** = 5.0 μm; Q = (1.35-) 1.46 - 2.10 (-2.16)); **Q** = 1.65.

CE: WV—Marion Co. - Mill Fall Run, 21.ix.1992 R. P. Bhatt, A. Kumar & S. L. Stephenson A1 (FWVA; RBHATT).



N. Macdonald del.

Fig. 1. *Amanita canescens* (Alabama, border of Shelby and Jefferson Cos., 22.viii.1984 C. Bas, D. T. Jenkins & R. E. Tulloss [Bas 9083] (L)). Habit (×0.7).

28. *AMANITA CINEREOPANNOSA* Bas (1, 8, 16)

This medium to large-sized amanita has a rooting bulb on its stipe the upper surface of which breaks into large roughly rectangular scales that suggest a brick wall. The off-white to pale grayish or pale grayish brown pileus is decorated by brownish gray, irregular, pointed warts that appear under a lens as if they were fashioned from dirty sand by clumsy hands—the irregular surface suggests the impressions of fingers. Fruiting bodies often have the odor of fresh biscuit dough. Found in mixed hardwood forests containing oaks.

SP: [35/1/1] (8.0-) 8.4 - 10.5 (-11.5) × (5.2-) 5.6 - 7.0 μm; **L** = 9.7 μm; **W** = 6.0 μm; Q = (1.30-) 1.50 - 1.78 (-1.88); **Q** = 1.63.

CE: WV—Greenbrier Co. - Monongahela Nat. For., Lk. Sherwood, R. E. Tulloss 8-31-82-E.

29. *AMANITA COKERI* (E. J. Gilb. & Kühner) E. J. Gilb. (11, 16, 43)

This elegant amanita is entirely white and often rather large. The warts on the pileus are neatly pyramidal, but can be washed away in rains. The stipe bears an apical to superior, double annulus; these annuli are often joined at a thickened margin; and the lower one bears many fibrils on its under side that connect it to the stipe. The rooting bulb has many concentric rows of pointed or recurved scales around its upper portion. The broad spores are an important character of the species. This mushroom is odorless in contrast to *A. species 5* (below). Found in oak-pine forests.

SP: [60/3/2] 10.8 - 13.2 (-15.0) × (6.8-) 7.5 - 8.7 (-9.5) μm; **L** = 11.5 -12.7 μm; **L'** = 12.1 μm; **W** = 7.8 - 8.1 μm; **W'** = 8.0 μm; Q = (1.27-) 1.33 - 1.67 (-1.73); **Q** = 1.44 - 1.56; **Q'** = 1.51.

CE: WV—Greenbrier Co. - Monongahela Nat. For., Lk. Sherwood, D. C. & R. E. Tulloss 9-1-82-B. Unknown Co. - Hunting Ridge, 13.viii.1960 Gladys Coon *et al. s.n.* (BPI).

30. *AMANITA DAUCIPES* (Mont.) Lloyd (1, 8, 16, 25)

This rather common, medium-sized to large mushroom has distinctive pinkish to salmon volval material on the pileus in the form of chunky cakes and/or needle-like warts. The annulus is weakly structured and soon falls away. The flocculent stipe and the upper bulb are often concolorous with the warts on the pileus. A felt-like piece of volval internal limb is often left loosely appressed to the lower stipe or the upper part of the bulb. The bulb can be very large and is turnip- to carrot-shaped. This species is more difficult to recognize when the volval material has lost some or all of its color with age. The color on the lower stipe is often the last to fade. When the color is faded, microscopic examination may be required for determination.

Found in hardwood forests containing oak.

SP: [40/2/2] (8.2-) 9.2 - 12.0 (-13.8) × (5.5-) 5.8 - 7.2 (-8.0) μm; **L** = 10.1 - 10.8 μm; **L'** = 10.4 μm; **W** = 6.4 - 6.5 μm; **W'** = 6.4 μm; Q = (1.22-) 1.42 - 1.80 (-1.92); **Q** = 1.57 - 1.68; **Q'** = 1.62.

CE: VA—Augusta Co. - Geo. Washington Nat. For., Todd Lk. Campground, M. A. King & D. C., M. H. & R. E. Tulloss 8-28-82-B. WV—Greenbrier Co. - Monongahela Nat. For., Lk. Sherwood, 31.viii.1982 D. C. Tulloss *s.n.* [Tulloss 8-31-82-B].

31. *AMANITA LONGIPES* Bas *ex* Tulloss & Jenkins (16)

This flocculent white mushroom has an often dog-legged, somewhat rooting, slender bulb on its stipe. It lacks an annulus. Its spores have larger Q than those of *A. chlorinosma* (with which it might be confused), and its basidia lack clamp connections. In New Jersey, it is found in forests composed of oak and pitch pine.

SP: [11/1/1] 9.1 - 11.9 × 4.5 - 6.3 μm; **L** = 10.8 μm; **W** = 5.9 μm; Q = 1.60 - 2.12; **Q** = 1.85. [The spores are small for the species; the single specimen examined may have been drying for some time before it was presented for determination.]

CE: No locality, 31.vii.1985 collector unknown *s.n.* [Tulloss 7-31-85-A]. [This collection, which appeared on a table at the NAMA 1985 foray on the first day, could have been extraregional.]

32. *AMANITA ONUSTA* (Howe) Sacc. (18)

This small to medium-sized species with an often deeply rooting bulb is locally common in the eastern United States. The pileus is dirty white to grayish or brownish gray with an appendiculate margin and many pyramidal brownish gray warts. The stipe is annulate when the pileus first expands, but soon becomes exannulate. The top of the bulb is decorated with several rows of recurved scales and/or small warts; the latter are concolorous with those on the pileus. Found in deciduous or mixed deciduous/coniferous forests containing oak.

SP: [40/2/2] (8.5-) 9.0 - 12.2 (-13.0) × 5.5 - 7.0 (7.5) μm; **L** = 9.5 - 11.0 μm; **L'** = 10.3 μm; **W** = 6.0 - 6.3 μm; **W'** = 6.1 μm; Q = (1.35-) 1.42 - 2.0 (-2.21); **Q** = 1.51 - 1.84; **Q'** = 1.68.

CE: VA—Franklin Co. - *ca.* Ferrum, *ca.* Ferrum College, 4.viii.1982 G. Bills, Pierre Dery, Orson K. Miller, Jr. & Hope H. Miller [OKM] 19946 (VPI as "*A. peckiana*"). WV—Marion Co. - Mill Fall Run, 21.ix.1992 R. P. Bhatt A2 (FWVA).

33. *AMANITA PELIOMA* Bas (9)

This distinctive fungus has café au lait lamellae and is otherwise entirely a sort of dirty tan. It is almost entirely covered with flocculence at first. The stipe has an evanescent annulus and an ellipsoid, undecorated bulb. The most distinctive feature of the species is the blue-green bruising, which is particularly to be noted on the lower stipe, but may also occur elsewhere. Recently *A. pelioma* was collected in southern New York state; this must be considered a rather rare occurrence. WV is in the northern portion of this species' range. The material examined was collected in mixed forest containing oak, white pine, maple, and yellow poplar.

SP: [60/3/1] (8.8-) 9.8 - 12.5 (-13.8) × (5.5-) 6.0 - 7.5 (-9.0) μm; **L** = 10.6 - 12.1 μm; **L'** = 11.1 μm; **W** = 6.5 - 6.9 μm; **W'** = 6.7 μm; Q = (1.42-) 1.50 - 1.88 (-2.22); **Q** = 1.59 - 1.76; **Q'** = 1.67.

CE: VA—Franklin Co. - Ferrum, *ca.* Ferrum College, 4.viii.1982 O. K. Miller, Jr. & H. H. Miller [OKM] 19940 (VPI 1587).

34. *AMANITA POLYPYRAMIS* (B. & C.) Sacc. (12, 16)

The pileus of this impressive species may reach dinner plate size, and the stipe may suggest a knobbed club the size of a policeman's stick. The pileus is covered with small pyramidal warts, and the bulb of the stipe is densely ringed with even smaller warts. The annulus is thick, but easily falls away and is lost.

SP: [40/2/2] (7.0-) 8.0 - 10.8 (-11.5) × (5.2-) 5.9 - 7.3 (-7.7) μm; **L** = 9.0 - 10.0 μm; **L'** = 9.5 μm; **W** = 6.5 - 6.7 μm; **W'** = 6.6 μm; Q = (1.11-) 1.27 - 1.68 (-1.74); **Q** = 1.35 - 1.50; **Q'** = 1.42.

CE: WV—Greenbrier Co. - Monongahela Nat. For., Lk. Sherwood, R. E. Tulloss 8-31-82-A, M. H. & R. E. Tulloss 9-2-82-C.

35. *AMANITA RAVENELII* (B. & C.) Sacc. (11, 16)

This medium to large mushroom has densely-packed, large, radially fibrillose warts on the pileus. The partial veil is submembranous and usually falls away. The very large, basal bulb ranges from turnip- to carrot-shaped or is sometimes rather irregular. It may be difficult to separate this entity from *A. rhopalopus* unless close attention is paid to the form and structure of the warts on the pileus. Microscopic details of the warts are part of the set of important distinguishing characters for this species (Bas, 1969). It is often found in pine-oak forests and in hardwood forests containing oaks.

SP: [60/3/3] (7.0-) 7.8 - 10.5 (-12.4) × (5.0-) 5.2 - 6.8 (-8.0) μm; **L** = 8.3 - 9.8 μm; **L'** = 9.1 μm; **W** = 5.6 - 6.1 μm; **W'** = 5.9 μm; Q = (1.32-) 1.37 - 1.72

(-1.77); **Q** = 1.49 - 1.64; **Q'** = 1.54.

CE: WV—Marion Co. - Barrackville, 5.x.1980 S. L. Stephenson 338 (FWVA). Ritchie Co. - no locality, 5.x.1993 S. L. Stephenson 93-03 (FWVA). Unknown Co. - no locality, 1985 NAMA foray participant *s.n.* [Tulloss 8-1-85-C].

36. *AMANITA RHOPALOPUS* Bas f. *RHOPALOPUS* (16, 18)

This medium to large-sized mushroom is named after its dog-legged, elongate bulb. This *Amanita* is white or whitish and has a rather easily lost annulus. The volval material on the pileus is in floccose patches or warts. See also *A. ravenelii* and *A. species 9* with which *A. rhopalopus* can be confused. Bas (1969) distinguished a f. *turbinata* (see below), which differs by having a large turnip or top-shaped bulb on the stipe.

SP: [20/1/1] (8.8-) 9.0 - 11.5 (-12.5) × (5.5-) 6.0 - 7.2 (-7.8) μm; **L** = 9.8 μm; **W** = 6.3 μm; Q = 1.42 - 1.74 (-1.75); **Q** = 1.56.

CE: WV—Marion Co. - Mill Fall Run, 22.ix.1993 S. L. Stephenson & D. Binion 93-01 (FWVA).

37. *AMANITA RHOPALOPUS* f. *TURBINATA* Bas (16)

This medium to large-sized mushroom is named for its large, top-shaped bulb. In other characters it is very similar to *A. rhopalopus* f. *rhopalopus* (above).

SP: [40/2/2] (8.2-) 8.5 - 12.8 (-14.5) × (5.0-) 5.8 - 7.8 (-9.0) μm; **L** = 9.1 - 10.3 μm; **L'** = 9.7 μm; **W** = 6.4 - 6.5 μm; **W'** = 6.5 μm; Q = (1.29-) 1.32 - 1.72 (-1.78); **Q** = 1.42 - 1.58; **Q'** = 1.50.

CE: WV—Hampshire Co. - Capon Springs, summer.1900 W. H. Walmsley *s.n.* (BPI). Pendleton Co. - Moyers, 7.ix.1992 Estelle K. T. Wagner *s.n.*

38. *AMANITA SPECIES 5* (16)

This is an elegant white mushroom with small pyramidal warts on the pileus; the stipe has an annulus that is sometimes double, but at the very least, has a thick margin with fibers on the underside stretching down to the stipe; the bulb is radicating and is encircled with relatively large, often recurved, scales and warts. This mushroom is very close in appearance to *A. cokeri*, but it stains brick-colored on the bulb more commonly, has a strong odor like a combination of burnt sugar and cedar wood or a skunk, and has slightly narrower spores than Bas (1969) reports for *A. cokeri*.

SP: [20/1/1] (9.8-) 10.0 - 11.8 (-12.5) × (5.8-) 6.2 - 7.8 μm; **L** = 10.8 μm; **W**

= 6.8 μm; Q = (1.38-) 1.46 - 1.70 (-1.77); **Q** = 1.59.

CE: WV—Greenbrier Co. - 1 mile W of Charmco, 9.viii.1990 M. A. Vincent 4381 (MU F38508).

39. *AMANITA SPECIES 9* (16)

This large, white mushroom has a yellowing, flocculent partial veil and a deeply rooting bulb—so deeply rooting that large specimens probably are never collected in their entirety. It is similar to *A. rhopalopus*, but (among other differences) has consistently narrower spores.

SP: [20/1/1] (7.0-) 7.7 - 11.2 (-12.6) × 4.9 - 5.9 (-6.6) μm; **L** = 9.6 μm; **W** = 5.3 μm; Q = (1.43-) 1.57 - 2.0 (-2.02); **Q** = 1.79.

CE: WV—Randolph Co. - Elkins, 3.viii.1985 C. Willet *s.n.* [Tulloss 8-3-85-C].

l. *AMANITA CHLORINOSMA* (Peck *in* Austin) Lloyd (7, 24)

This white mushroom is medium to large-sized and is well-known to be covered with flocculence. Sometimes the volval material in the center of the pileus will form coherent, small warts. The stipe lacks an annulus and has an ovoid to ventricose bulb at the base. The name of the species indicates its supposed odor of chlorine; the odor is certainly relatively strong and unpleasant. The name "*chlorinosma*" is very widely misapplied. However, the species is relatively rare, with a known range extending from Florida northwestward to Illinois and northeastward to Vermont. The relatively small spores, the elements of the universal veil [see (Bas, 1969)], and the easily found clamp connections at the base of basidia aid in diagnosis of this *Amanita*. It has been found in association with oak. **SP**: (8.0-) 8.5 - 10.5 (-11.0) × 5.0 - 6.0 μm; **Q** = 1.7 - 1.8.

m. *AMANITA CINEREOCONIA* Atk. var. *CINEREOCONIA* (1, 8, 25)

This relatively small mushroom has a very distinctive form: The pileus bears a layer of gray, pulverulent universal veil; and the pileus margin is appendiculate with what appear to be white, flocculent icicles. The stipe is exannulate and bears a small ellipsoid bulb. **SP**: 8.5 - 11.5 (-12.5) × (4.5-) 5.0 - 6.5 μm; **Q** = 1.70 - 1.90.

SUBGENUS *Lepidella* SECTION *Amidella* (E. J. Gilb.) Konr. & Maubl.

This section contains curious exceptions to the general rule that the presence of amyloid spores in an *Amanita* is associated with a nonstriate pileus margin and attenuate lamellulae. Many of the species in this section will develop a striate margin if they do not already have one when expanding out of the volval sac. The margin of the pileus is appendiculate at first, but this material may disappear rather quickly. In the taxa described below, a membranous calyptra is *usually* not left on the pileus. However, it is a characteristic of North American taxa in the section that they leave fibrous or flocculent, browning remnants of the thin inner layer of the universal veil spread over the pileus. All parts of the fruiting body will turn red-brown or brown eventually if wounded; and, under the proper environmental conditions, the fruiting bodies will often exhibit a transient pink bruising reaction when the flesh is scratched with a knife blade or a fingernail. The stipe is usually exannulate although one may find a membranous annulus early in the expansion of *A. peckiana*, and other species (for example, *A. volvata*) will exhibit a flocculent annular zone when freshly expanded. Unlike other sections of the genus, most members of this section that have been spot tested for laccase have exhibited a positive reaction in at least some part, if not all, of the fruiting body (Tulloss, unpub. data). A monograph on the Canadian, Mexican, and U.S. taxa of this section is under preparation by Tulloss.

Not yet collected in the region, but to be expected: There is an additional, undescribed taxon (*Amanita species N39* with mostly cylindric to bacilliform spores and a subhymenium containing numerous inflated cells) that has been collected from western North Carolina to southeastern Canada. The distinctive spores of this entity are (8.1-) 9.9 - 16.2 (-21.0) × (3.8-) 4.0 - 6.2 (-7.8) μm, with Q = 2.30 - 2.88.

KEY

1. Having true membranous annulus early in expansion of fruiting body; having plentiful hyphae in subhymenial region running parallel to central stratum of lamella; spores (7.1-) 9.7 - 15.0 (-26.6) × (3.4-) 4.2 - 6.8 (-9.2), with Q = (1.73-) 1.86 - 2.93 (-3.08).. *Amanita peckiana.*

1. Differing in all characters from above.

  2. Universal veil as long and flaring, saccate volva; subhymenium composed of elements diverging from central stratum in broad sweeping curve; spores (7.0-) 8.8 - 12.0 (-14.1) × (4.3-) 4.8 - 6.5 (-8.2) μm, with Q = (1.61-) 1.66 - 2.04 (-2.13).. *Amanita species 50.*

  2. Differing in all characters from above. Note: volva sometimes elongate, but then usually tubular.

    3. Fruiting body usually rather slender; universal veil as saccate to tubular volva; subhymenial tree containing numerous narrow chains of cells running perpendicular to central stratum of lamella; spores (7.0-) 8.8 - 12.5 (-24.0) × (4.0-) 4.9 - 6.2 (-10.0) μm, with Q = (1.64-) 1.70 - 2.12 (-2.26).......... *Amanitopsis volvata* var. *elongata.*

    3. Subhymenium without such structure and differing in one or more other characters from above.

      4. Fruiting body usually rather robust; universal veil as thick, subglobose volva; subhymenium cellular (without obvious ordering of elements); spores (5.8-) 8.4 - 12.0 (-14.2) × (4.5-) 5.2 - 7.2 (-9.0) μm, with Q = (1.39-) 1.48 - 1.83 (-1.93)... *Amanita volvata* var. *volvata.*

      4. Fruiting body usually rather small; universal veil as subglobose to ovoid volva; subhymenial base divergent in smooth slow curve; cells of subhymenium still not aligned perpendicularly to hymenial surface 1-2 cells

away from base of basidia; spores (5.0-) 8.0 - 11.0 (-13.0) × (3.8-) 4.5 - 6.0 (-7.2) μm, with **Q** = (1.42-) 1.64 - 2.04 (-2.14)........................... *Amanita species 41.*

40. *AMANITA PECKIANA* C. H. Kauffm. *in* Peck (16)

This species differs from others of section *Amidella* found in the region of study by having a true membranous annulus at the point at which the pileus begins to expand out of the volval sac. The annulus, however, is rapidly lost. The elongate to cylindric spores are also an important character. The strongest distinguishing character is microscopic. The subhymenium of *A. peckiana* contains plentiful hyphae running parallel to the hymenial surface and located just below the bases of the basidia. Kauffman said the fruiting bodies sometimes have the odor of radishes. The two fruiting bodies collected in the region to date were collected in very rainy periods. Tulloss (unpub. data) has observed that in wet conditions the spores of *A. peckiana* are shorter and broader than would be expected on average.

SP: [65/2/2] (9.0-) 9.8 - 13.6 (-14.7) × 5.6 - 7.0 (-9.1); **L** = 11.2 - 12.0 μm; **L'** = 11.7 μm; **W** = 5.5 - 6.2 μm; **W'** = 6.0 μm; Q = (1.48-) 1.69 - 2.25 (-2.54); **Q** = 1.93 - 2.06; **Q'** = 1.97.

CE: WV—Greenbrier Co. - Monongahela Nat. For., Lk. Sherwood, D. C. & R. E. Tulloss 9-1-82-A. Tucker Co. - Horseshoe Run, 3.viii.1985 G. G. Kibby *s.n.* [Tulloss 8-3-85-B].

41. *AMANITA VOLVATA* (Peck) Lloyd (16, 18)

This medium-sized mushroom has a subglobose, very thick-walled volval sac that makes it appear that the base of the stipe is bulbous. Sectioning the fruiting body longitudinally will correct this impression. The stipe is exannulate, but has a dense floccose region near the apex when young. The inner layer of the universal veil is sometimes left so completely on the pileus that the unexpanded pileus has the appearance of a filbert nut with a fibrous, brown coating. All parts of the mushroom, but particularly the inner layer of the universal veil and the flocculence on the stipe, will oxidize brick-red or red-brown rather rapidly. The subhymenium of this species is cellular (pseudoparenchymatous). Found in forests containing oak—including oak-hickory-white pine forests.

SP: [65/3/3] (7.8-) 8.4 - 11.8 (-13.2) × (4.5-) 5.0 - 6.6 (-7.7) μm; **L** = 9.6 - 10.7 μm; **L'** = 9.9 μm; **W** = 5.2 - 6.4 μm; **W'** = 5.6 μm; Q = (1.27-) 1.42 - 2.24 (-2.54); **Q** = 1.52 - 2.02; **Q'** = 1.80.

CE: OH—Ross Co. - Scioto Trails St. For., 20.vii.1969 W. B. & V. G. Cooke 39604 (MU F6344). VA—Craig Co. - John's Crk., 30.viii.1978 P. C. Hammond 36 *p.p.* (VPI, mixed collection). Montgomery Co. - Craig Crk., 19.viii.1978 P. C.

Hammond 14 (VPI as *A. peckiana*).

42. *AMANITOPSIS VOLVATA* var. *ELONGATA* Peck (16)

This is a medium-sized mushroom that is initially white and takes on tan or brownish tints as it ages. The inner layer of the universal veil is left in what appear to be cuneiform characters around the slightly striate pileus margin. The stipe is exannulate and often more than 10× longer than wide. In larger specimens, the stipe is often somewhat sinuate. The universal veil is saccate, tough, and often completely buried in the soil. The subhymenial tree of this species consists of branching rows of small cells that seem to turn a right angle at the central stratum of the trama and make a beeline for the base of the basidia. This entity is not appropriately placed as a var. of *A. volvata*. For this reason we do not bother to move it to *Amanita*. It will be raised to specific rank in the monograph on section *Amidella* in North America mentioned above. Found in beech-oak-hickory forests, forests of mixed oaks and Virginia pine, and oak-hickory-white pine forests.

SP: [58/3/3] (8.0-) 8.5 - 11.2 (-12.2) × (4.8-) 5.0 - 6.2 μm; **L** = 8.9 - 10.6 μm; **L'** = 9.7 μm; **W** = 5.2 - 5.6 μm; **W'** = 5.4 μm; Q = (1.55-) 1.59 - 2.08 (-2.35); **Q** = 1.72 - 1.91; **Q'** = 1.81.

CE: VA—Craig Co. - John's Crk., 30.viii.1978 P. C. Hammond 36 *p.p.* (VPI, as *A. volvata*, mixed collection). Giles Co. - Pandapus Pond Rec. Area, 13.ix.1988 O. K. Miller 23138 (VPI as *A. peckiana*). WV—Preston Co. - Eglon, vii.1902 C. G. Lloyd 02288 (NYS).

43. *AMANITA SPECIES 41* (16)

This entity is a small mushroom with a subglobose to ovoid volval sac, a pileus margin that is striate almost from the moment that the pileus expands from the volval sac, and rather small spores (for the section) that often have **W** less than 5.5 μm. Its known range extends from the northeastern states to the Gulf Coast. Found under white oak and pignut hickory [*Carya glabra* (Mill.) Sweet] and in oak-hickory-white pine forests.

SP: [40/2/2] (7.5-) 8.5 - 11.0 (-12.5) × (4.5-) 4.8 - 5.8 (-6.2) μm; **L** = 9.1 - 10.1 μm; **L'** = 9.6 μm; **W** = 5.0 - 5.2 μm; **W'** = 5.1 μm; Q = (1.47-) 1.61 - 2.16 (-2.50); **Q** = 1.74 - 2.02; **Q'** = 1.88.

CE: VA—Craig Co. - John's Crk., 30.viii.1978 P. C. Hammond 36 *p.p.* (VPI as *A. volvata*, mixed collection). Montgomery Co. - along Mud Pike, James Page property, 17.vii.1981 G. Bills 108 (VPI as *A. volvata*).

44. *AMANITA SPECIES 50* (16)

This is a medium-sized mushroom with an elongate, tough volval sac that often encloses half or more of the stipe; the top of this sac may flare outward. The stipe is exannulate but has a floccose region near the apex in young specimens. The stipe is stockier than that of *Amanitopsis volvata* var. *elongata*. The species is distinguished by the large volval sac and a subhymenium composed of small cells and uninflated hyphal segments in a layer 2 - 3 cells deep. Unlike the other species of this section described here, this species has occasional clamps at the base of basidia. Found in deciduous forests containing oak.

SP: [40/2/2] (8.0-) 9.5 - 11.2 (-13.5) × (4.5-) 4.8 - 5.8 (-7.0) μm; **L** = 10.3 - 10.4 μm; **L'** = 10.3 μm; **W** = 5.2 - 5.5 μm; **W'** = 5.3 μm; Q = (1.50-) 1.78 - 2.16 (-2.22); **Q** = 1.89 - 1.98; **Q'** = 1.94.

CE: WV—Randolph Co. - Elkins, 3.viii.1985 C. Willet *s.n.* [Tulloss 8-3-85-A]. Tucker Co. - Horseshoe Run, 3.viii.1985 NAMA foray participant *s.n.* [Tulloss 8-3-85-I].

SUBGENUS *Lepidella* SECTION *Phalloideae* (Fr.) Quél.

In general, this section contains species with nonstriate, nonappendiculate pileus margins. While many of the species have a strongly pigmented pileus, there are some that are totally white. In this section, the stipe is always annulate. Section *Phalloideae* is sometimes divided into two sections. One is typified by an abrupt basal bulb on the stipe that very rarely exhibits much of a volval limb (*e.g.*, *A. citrina* and *A. brunnescens*); the other contains taxa having stipes with a basal bulb exhibiting a membranous, limbate volva (*e.g.*, *A. virosa*). A number of the species of the second group contain deadly amatoxins.

KEY

1. Basal bulb of stipe firm and abrupt with longitudinal splitting; fruiting body medium to large; all parts of fruiting body with orange-brown, reddish brown to brown staining after handling, bruising or cutting.
    2. Pileus some shade of brown to olive-brown at first; spores (7.0-) 7.5 - 9.2 (-9.5) × (6.5-) 7.0 - 8.5 (-9.2) μm, with **Q** = 1.08................................ *Amanita brunnescens* var. *brunnescens*.
    2. Pileus white to pale yellowish, eventually pallid with slightly yellowish disc; spores (5.8-) 7.0 - 9.2 (-10.8) × (5.0-) 6.5 - 8.8 (-10.0) μm, with **Q** = 1.06 - 1.07... *Amanita aestivalis*.
1. Basal bulb not as above or else fruiting body small and delicate; no part of fruiting body strongly staining or bruising as above or, if so, then having subglobose bulb with distinct, limbate volva.
    3. Fruiting body small and rather delicate; pileus some shade of brown or olive-

brown, sometimes decolored over disc; spores (6.6-) 7.2 - 9.0 (-10.8) × (5.9-) 6.6 - 8.5 (-10.1) μm, with Q = 1.06 - 1.11... *Amanita species O2.*

3. Not as above.

4. Pileus pigmented.

5. Pileus streaked with olive, brown, and yellowish tones; bulb having distinct, white volval limb; spores (7.5-) 7.8 - 10.8 (-12.0) × 6.0 - 8.0 (-10.8) μm, with Q = 1.23 - 1.29... *Amanita phalloides.* [Not confirmed for region of study.]

5. Pileus not streaked; bulb with volval limb usually quite abbreviated or absent, often discoloring brownish, sometimes with lavender tint; Meixner test for amatoxins negative.

6. Pileus some shade of brown; annulus gray; universal veil limb always lacking lavender tints; spores (7.5-) 7.8 - 9.8 (-11.2) × (7.0-) 7.2 - 9.2 (-11.0) μm, with Q = 1.05 - 1.07.. *Amanita porphyria.* [Not confirmed for region of study.]

6. Pileus citron yellow to pale citron yellow, sometimes with sordid or gray areas when damaged; annulus pale yellowish at first, becoming sordid with age; universal veil limb may have lavender tints.

7. Universal veil without lavender tints; spores (6.0-) 7.0 - 9.5 (-11.0) × (5.8-) 6.8 - 9.0 (-10.2) μm, with Q = 1.05 - 1.06........................ *Amanita citrina* f. *citrina.*

7. Universal veil with lavender tints; spores (Jenkins, 1986) 5.5 - 7.0 × 5.5 - 7.0 μm, with Q = 1.04.. *Amanita citrina* f. *lavendula.* [Not confirmed for region of study.]

4. Pileus white at least at first; limb of volva membranous and often 5 or more mm high, not discoloring, never with lavender tint; Meixner test for amatoxins almost always positive.

8. Spores globose to subglobose to broadly ellipsoid.

9. Basidia dominantly bisterigmate; spores (5.2-) 7.2 - 9.9 (-11.0) × (4.8-) 6.4 - 8.5 (-10.0) μm, with Q = (1.05-) 1.06 - 1.16 (-1.18)................. *Amanita bisporigera.*

9. Basidia dominantly 4-sterigmate.

10. Fruiting body not squat, not notably staining from handling, always giving yellow reaction to KOH solution; spores (7.0-) 7.5 - 10.0 (-13.2) × (6.0-) 7.0 - 9.5 (-11.5) μm, with Q = 1.06 - 1.11 (-1.13).... *Amanita virosa sensu auct. amer.*

10. Somewhat squat fruiting body, staining brown on surfaces where handled, sometimes giving yellow reaction to KOH solution; spores (6.8-) 7.5 - 9.5 (-10.2) × (6.2-) 7.0 - 9.0 (-9.2) μm, with Q = 1.07 - 1.09... *Amanita species O1.*

8. Spores broadly ellipsoid to ellipsoid to elongate.

11. Universal veil limb roughly parallel to stipe surface; bulb often subabrupt and/or pointed below; spores (6.8-) 8.4 - 11.2 (-16.3) × (4.8-)

5.8 - 8.0 (-11.0) μm, with **Q** = (1.35-) 1.37 - 1.57 (-1.65)................. *Amanita magnivelaris.*

11. Not as above.

12. Spores (7.3-) 8.4 - 11.2 (-13.5) × (4.9-) 5.5 - 6.8 (-8.5) μm, with **Q** = 1.50 - 1.60 (-1.69).. *Amanita species S4.*

12. Spores (Jenkins, 1986) 8.1 - 11.3 × 6.6 - 8.8 μm, with **Q** = 1.31.... *Amanita verna.* [Not confirmed for North America.]

45. AMANITA AESTIVALIS Sing. *ex* Sing. (16)

This mushroom has a very pale yellowish cream to white pileus with a yellowish disc. Pale citron-capped material otherwise identical to *A. brunnescens* has also been called *A. brunnescens* var. *pallida* Krieger (see below). However, a thorough study of Krieger's material has not been made; so it is not known for certain if *A. brunnescens* var. *pallida* is a synonym of *A. aestivalis* or not. The material we examined fits Singer's original description of this species. Pale citron specimens of *A. brunnescens* often develop umbrinous streaks on the pileus before or at maturity.

SP: [20/1/1] (7.0-) 7.2 - 8.5 (-8.8) × 6.8 - 8.2 (-8.5) μm; **L** = 7.9 μm; **W** = 7.5 μm; Q = 1.03 - 1.09 (-1.15); **Q** = 1.06.

CE: WV—Greenbrier Co. - rest stop along U.S. Rt. 60, *ca.* 1 mile W of Charmco, 9.viii.1990 M. A. Vincent 4383 (MU F38506).

46. AMANITA BISPORIGERA Atk. *in* Lewis (8, 16, 24, 40, 42)

This mushroom is entirely white with globose bulb and limbate volva. Its pileus turns yellow rapidly when a drop of KOH solution is placed on it. It is named for the fact that its basidia are predominantly 2-spored, rather than 4-spored as in most species of *Amanita*. This entity is often smaller than *A. virosa sensu auct. amer.* and seems to be more frequent in the earlier part of the mushrooming season. Found with oak and in oak-pine forests. DEADLY POISON.

SP: [100/5/4] (6.2-) 7.0 - 10.2 (-11.0) × (5.8-) 6.2 - 9.0 (-10.2) μm; **L** = 8.3 - 9.2 μm; **L'** = 8.7 μm; **W** = 7.2 - 7.9 μm; **W'** = 7.6 μm; Q = (1.02-) 1.04 - 1.27 (-1.47); **Q** = 1.07 - 1.18; **Q'** = 1.14.

CE: VA—Bath Co. - Hot Springs, 23.viii.1918 G. F. Atkinson 25476 H31-1 (CUP-A). Page Co. - Skyline Drive, S of Big Meadows, 23.viii.1989 E. H. Varney *s.n.* [Tulloss 8-23-89-EHV]. WV—Pocahontas Co. - Monongahela Nat. For., Droop Mtn., 26.viii.1977 K. H. McKnight *s.n.* (BPI 14709). Tucker Co. - Fernow Exp. For., 4.ix.1992 S. L. Stephenson, R. P. Bhatt & A. Kumar WS13-114 (FWVA).

47. *AMANITA BRUNNESCENS* Atk. var. *BRUNNESCENS* (11, 16, 25, 42)

This mushroom has an umbrinous brown pileus on which the color is often clearly in radial streaks. The stipe has a superior annulus and a subabrupt bulb that is markedly cleft in several places around its perimeter. These longitudinal clefts give the impression of a cloven hoof. The entire fruiting body will slowly stain or bruise brownish after handling or cutting. This species is very distinctive because of its bulb, pileus color, oxidation reaction, and small subglobose spores; however, it has a history of mistaken identification. Until Atkinson recognized it as a distinct species, it was called *A. phalloides* in North America. Illustrators went so far as to give it a globose bulb with limbate volva in their watercolors—because it *ought* to have had one! While a number of mycologists have reported it to be edible when cooked, others warn of confusing it with *Amanita rubescens* or believe it to be poisonous. *We do not encourage culinary experimentation with amanitas.* Found in diverse forest types—for example, beech-oak-hickory forests or forests containing pines, hemlock, and striped maple.

SP: [35/2/2] (7.0-) 7.5 - 9.2 (-9.5) × (6.5-) 7.0 - 8.5 (-9.2) μm; **L** = 8.2 - 8.7 μm; **L'** = 8.5 μm; **W** = 7.6 - 8.0 μm; **W'** = 7.8 μm; **Q** = (1.0-) 1.03 - 1.15 (-1.18); **Q** = 1.08; **Q'** = 1.08.

CE: WV—Greenbrier Co. - rest stop on U.S. Rt. 60, *ca.* 1 mile W of Charmco, 9.viii.1990 M. A. Vincent 4384 (MU F38505). Marion Co. - Mill Fall Run, 5.x.1993 S. L. Stephenson 93-02 (FWVA) [few or no mature spores]. Tucker Co. - Fernow Exp. For., Fork Mountain Rd., 18.ix.1992 S. L. Stephenson, R. P. Bhatt & A. Kumar FMR-1 (FWVA).

48. *AMANITA CITRINA* (Schaeff.) Pers. f. *CITRINA* (13, 16, 24, 25, 42)

This small to medium mushroom has a pale yellowish to yellowish green pileus often marked with thin brownish scales of volval material. The stipe and its superior annulus are often concolorous with the pileus (at least in early development). The stipe has a soft, subglobose, subabrupt, basal bulb that is slightly marginate. This is one of the most common late Fall species of *Amanita* in the region of study. A form common to the south of WV especially when the weather has become cold in the Fall (f. *lavendula*) has lavender tints to the volval material (see below). Occurs in mixed hardwood forests containing red oak, beech, and sugar maple.

SP: [60/3/3] (6.0-) 7.0 - 9.5 (-11.0) × (5.8-) 6.8 - 9.0 (-10.2) μm; **L** = 8.0 - 8.6 μm; **L'** = 8.3 μm; **W** = 7.6 - 8.2 μm; **W'** = 7.9 μm ; **Q** = 1.0 - 1.09 (-1.20); **Q** = 1.05 - 1.06; **Q'** = 1.05.

CE: WV—Tucker Co. - Fernow Exp. For., 13.ix.1992 R. P. Bhatt & A. Kumar FMR-5 (FWVA), 25.ix.1992 S. L. Stephenson, R. P. Bhatt & A. Kumar PW-2 (FWVA); Fernow Exp. For., Watershed 4, 8.x.1993 S. L. Stephenson 93-09 (FWVA).

49. *AMANITA MAGNIVELARIS* Peck (16, 39, 42)

= *Amanita elliptosperma* Atk.

This medium to large-sized mushroom is white with sometimes faintly to rather markedly pinkish lamellae. The stipe has a superior, white, skirt-like annulus. It is odorless or may have an odor of *A. phalloides* with hint of chlorine. The bulb is ellipsoid and soft with limbate universal veil having a separating, papery thin, fibrillose, inner layer. The Randolph Co. collection was made in dark loam in a disturbed area under hemlock, maple, birch, white oak, and other oaks. The Greenbrier Co. collection was made under pines, hemlock, and striped maple. The Tucker Co. collections were made in wet glades or other swampy places both in deciduous forests and in forests containing hemlock, spruce, and birch. In the field, lack of a reaction to KOH solution on the pileus and a positive spot test for tyrosinase will prevent confusion with *A. bisporigera* and *A. virosa sensu auct. amer.*; however, these indications are not sufficient for the diagnosis of the species. It is tentatively separated from *Amanita species S4* by microscopic characters. DEADLY POISON.

SP: [198/9/9] (7.8-) 8.5 - 11.5 (-13.3) × (5.2-) 6.0 - 8.0 (-8.5) μm; **L** = (9.1-) 9.6 - 10.8 μm; **L'** = 10.0 μm; **W** = 6.5 - 7.3 μm; **W'** = 6.8 μm; Q = (1.21-) 1.29 - 1.62 (-1.71); **Q** = 1.40 - 1.49 (-1.50); **Q'** = 1.43.

CE: VA—Augusta Co. - Elkhorn Lk., D. C. & R. E. Tulloss 8-27-82-A, R. E. Tulloss 8-29-82-A. WV—Greenbrier Co. - 1 mile W of Charmco, 9.viii.1990 M. A. Vincent 4385 (MU F38507). Marion Co. - Mill Fall Run, 21.ix.1992 R. P. Bhatt, A. Kumar & S. L. Stephenson A3 (FWVA). Randolph Co. - Alpena, Shaver's Mtn., Alpena Gap, 2.viii.1985 S. Stein *s.n.* [Tulloss 8-2-85-A]. Tucker Co. - Canaan Valley St. Pk., north fork of Red Run in Mozark Mtn. Quadrangle N, 3.viii.1985 R. L. Blanton *s.n.* [Tulloss 8-3-85-H]; Dolly Sods, 3.viii.1985 D. Huffman *s.n.* [Tulloss 8-3-85-F]; Fernow Exp. For., 25.ix.1992 R. P. Bhatt, A. Kumar & S. L. Stephenson A7 (FWVA), 28.viii.1992 S. L. Stephenson, R. P. Bhatt & A. Kumar WS1-1 (FWVA).

50. *AMANITA VIROSA sensu auct. amer.* (3, 16, 42)

Rather common throughout the region, this mushroom is entirely white and has a globose bulb with a limbate volva. Its pileus turns yellow rapidly when a drop of KOH solution is placed on it. The species differs from *A. bisporigera* by having basidia that are dominantly 4-spored. The European *A. virosa* is a small mushroom with an irregular pileus and shaggy stipe. It is considered by European authors to be limited to northern Europe and/or to montane forests. The North American entity is distributed very widely in hot, even rather dry, oak-pine forests among other habitats and usually has a very regularly shaped pileus. DEADLY POISON.

SP: [104/6/6] (7.0-) 7.8 - 10.0 (-13.2) × (6.5-) 7.0 - 9.5 (-11.5) μm; **L** = 8.4 - 9.4 (-9.5) μm; **L'** = 8.9 μm; **W** = 7.9 - 8.6 (-8.8) μm; **W'** = 8.3 μm; Q = 1.02 -

1.13 (-1.21); **Q** = 1.06 - 1.07 (-1.11); **Q'** = 1.07.

CE: WV—Greenbrier Co. - Greenbrier St. For., 26.viii.1980 S. L. Stephenson 186 (FWVA). Marion Co. - Mill Fall Run, 15.ix.1984 S. Emmel 623 (FWVA), 5.x.1993 S. L. Stephenson & J. Spooner 93-07 (FWVA). Ritchie Co. - Murphy Preserve, 20.ix.1980 S. L. Stephenson 244 (FWVA). Tucker Co. - Fernow Exp. For., 4.ix.1992 S. L. Stephenson, R. P. Bhatt & A. Kumar WS13-118 (FWVA); Fernow Exp. For., Fork Mtn. Rd., 9.x.1992 S. L. Stephenson, R. P. Bhatt & A. Kumar WS7-2 (FWVA), 8.x.1993 S. L. Stephenson 93-08 (FWVA) [few or no mature spores].

51. *AMANITA SPECIES O1* (16)

This mushroom has a white pileus that sometimes becomes brownish with age and lacks any remnants of universal veil. The stipe is white, robust, and browns with handling; it has a delicate, skirt-like, subapical partial veil; at the stipe base, is a subglobose bulb with a limbate universal veil that browns with age. KOH solution on the pileus sometimes produces a yellow reaction. A drop of H_2SO_4 on the lamellae will give rise to a purple spot.

SP: [53/2/2] (6.8-) 7.5 - 9.5 (-10.2) × (6.2-) 7.0 - 9.0 (-9.2) μm; **L** = 8.5 - 8.6 μm; **L'** = 8.5 μm; **W** = 7.9 μm; **W'** = 7.9 μm; Q = 1.0 - 1.14 (-1.20); **Q** = 1.07 - 1.09; **Q'** = 1.07.

CE: OH—Mahoning Co. - Youngstown, Forest Lawn Cemetery, W. Sturgeon *s.n.* [Tulloss 10-10-83-WS1], *s.n.* [Tulloss 10-25-86-WS1].

52. *AMANITA SPECIES O2* (16)

This mushroom is very small and slender. Its pileus has pigmentation like that of *A. brunnescens*, but the bulbous stipe base has a limbate universal veil. Its partial veil is white. Sometimes there are unpigmented or lightly pigmented regions on the pileus, especially near the center. This entity may be close to *A. solaniolens* Stewart and Grund (1974).

SP: [80/4/4] (7.0-) 7.5 - 9.2 (-10.8) × (6.3-) 6.6 - 8.5 (-10.1) μm; **L** = 8.0 - 8.8 μm; **L'** = 8.4 μm; **W** = 7.5 - 7.9 μm; **W'** = 7.7 μm; Q = 1.0 - 1.15 (-1.28); **Q** = 1.06 - 1.11; **Q'** = 1.09.

CE: WV—Pendleton Co. - Onego Quadrangle, Seneca Creek/White's Run, 3.viii.1985 M. Goldman *s.n.* [Tulloss 8-3-85-E]. Tucker Co. - Fernow Exp. For., 4.ix.1992 S. L. Stephenson, R. P. Bhatt & A. Kumar WS13-108 (FWVA) & WS7-101 (FWVA); Horseshoe Run, M. A. King, D. C. & R. E. Tulloss 8-3-85-G.

53. *AMANITA SPECIES S4* (16)

This mushroom superficially resembles *A. virosa sensu auct. amer.* It is a large white mushroom with little, if any, universal veil left on the pileus in the usual course of things. The stipe is annulate and there is a subglobose to ellipsoid bulb on the stipe with an upstanding volval limb forming a rough, short cylinder around the stipe base before the limb collapses. The odor ranges from mild to that of chlorine. There are a number of distinguishing microscopic characters not the least of which are the ellipsoid to elongate spores; macroscopically this entity can be distinguished from *A. bisporigera* and *A. virosa sensu auct. amer.* by the facts that its pileus will *not* turn yellow in a KOH spot test and that its flesh will show a *strong positive* reaction to spot testing for tyrosinase. Separation from *A. magnivelaris* is on the basis of microscopic characters. It has been collected in mixed forests under pine, hemlock, and striped maple and in mixed forests under hemlock, beech, and maple.

SP: [20/1/1] (8.8-) 9.0 - 10.8 (-12.5) × 5.8 - 6.5 (-6.8) μm; **L** = 9.8 μm; **W** = 6.1 μm; Q = (1.42-) 1.50 - 1.66 (-1.92); **Q** = 1.59.

CE: WV—Greenbrier Co. - woods above rest stop on U.S. Rt. 60, *ca.* 1 mile W of Charmco, 9.viii.1990 M. A. Vincent 4382 (MU F38509).

n. *AMANITA BRUNNESCENS* var. *PALLIDA* Krieger (8, 16)

This var. has a pale citron to white pileus. Pure white material otherwise identical to *A. brunnescens* has also been called *A. aestivalis* Sing. *ex* Sing. (see above). A number of authors have expressed reservation about maintaining this var. of *A. brunnescens*. Tulloss has collected specimens of *A. brunnescens* in South Carolina that were intermixed with regard to pileus coloration; one specimen exhibited a pileus that was divided almost precisely in half, with one side umbrinous brown and the other pale citron/cream with occasional umbrinous streaks. Jenkins (1986) reported no microscopic difference between the two varieties. Their habitats are similar.

o. *AMANITA CITRINA* f. *LAVENDULA* (Coker) Veselý (42)

This mushroom is of the same form and basic color as *A. citrina* f. *citrina*, but has lavender tints to the volval material on the pileus and on the brief limb around the margin of the bulb. Many collections of *A. citrina* f. *citrina* have pale reddish brown tints in the same places. A critical comparison to color charts is helpful in determining this taxon. Reported from the region of study, but exsiccata could not be determined with certainty. **SP**: 5.5 - 7.0 × 5.5 - 7.0 μm; **Q** = 1.04.

p. *AMANITA PHALLOIDES* Link *in* Willd.:Fr. (43)

This is a species apparently introduced from Europe as a symbiont of exotic oaks and pines. Its pileus is radially streaked with tones of olive, brown. and yellow. The white stipe has a large, subglobose bulb with a volva very much like that of *A. bisporigera*. The odor of this mushroom soon becomes sickeningly sweet. DEADLY POISON.

q. *AMANITA PORPHYRIA* Albertini & Schw.:Fr. (16, 18)

This mushroom is similar in habit to *A. citrina*. Its pileus ranges from a sordid olivaceous tan to a purplish brown. It is notable for having a gray annulus on its pallid stipe. It was described from Europe, but is claimed from northeastern North America by many authors. **SP**: (7.5-) 7.8 - 9.8 (-11.2) × (7.0-) 7.2 - 9.2 (-11.0) μm; **Q** = 1.05 - 1.07.

r. *AMANITA VERNA sensu auct. amer.* (12, 24, 25)

This name has been applied in North America to white species similar in form to *A. bisporigera* and *A. virosa*, which have broadly ellipsoid to ellipsoid spores and the pilei of which do not have a yellow reaction to KOH solution. Probably, at least some of the past WV records of this species refer to *A. magnivelaris*, as do many records that Tulloss has checked for other regions of the U.S. and Canada. Whether the true European *A. verna* occurs in the U.S. is not clear to us. DEADLY POISON. **SP**: 8.1 - 11.3 × 6.6 - 8.8 μm; **Q** = 1.31.

SUBGENUS *Lepidella* SECTION *Validae* (Fr.) Quél.

The species of this section have a nonstriate, nonappendiculate pileus margin and never have a limbate volva—although sometimes a submembranous patch of universal veil material will be left on the lower stipe or upper bulb. The pileus is often strongly pigmented in these species. The universal veil often is very crumbly and will remain on the pileus only as small to large warts that are easily washed off by rain. It is common for the universal veil material around the bulb to be left in the soil when one of these species is collected. In several species there is yellow pigmentation in the universal veil.

Not yet collected in the region, but to be expected: *Amanita salmonescens* Tulloss (1990a) is known from pine-oak forests in western South Carolina and from deciduous forests in central New Jersey. It is a white mushroom with a stipe that easily bruises salmon color from handling. In addition, there is an entirely white, apparently undescribed entity (*Amanita species N5*) that develops no staining or bruising of any kind and has an ellipsoid to subfusiform bulb on its stipe with a distribution similar to that of *A. salmonescens*.

KEY

1. Fruiting body bruising wine-colored, reddish brown, or some shade of red at least in base of stipe.
  2. Pileus yellow or yellowish at first; partial veil yellow on upper surface; stipe often yellow; spores (Jenkins, 1986) 9.7 - 10.2 × 6.3 - 7.0 μm, with Q = 1.42.. *Amanita flavorubescens*.
  2. Pileus lacking yellow tints at all stages of development; partial veil not yellow on upper surface; stipe never yellow.
    3. Pileus white at first; spores (Tulloss and Lindgren, 1994) (6.5-) 7.0 - 9.8 (-10.5) × (4.5-) 5.0 - 7.0 (-8.5) μm, with Q = 1.34 - 1.49 (-1.50)........... *Amanita rubescens* var. *alba*.

3. Pileus yellowish cream or pale yellowish tan or brassy or pale brown or rosy brown or brown; spores (7.0-) 7.3 - 9.5 (-9.8) × (5.6-) 5.9 - 7.0 (-7.3) μm, with Q = 1.23 - 1.38.. *Amanita rubescens sensu auct. amer.*

1. Fruiting body occasionally with some reddish or rusty stains, but without distinctive wine-colored, reddish brown or red bruising in any part of stipe context or on stipe exterior.

4. Pileus brilliant yellow or yellow orange; spores (6.5-) 6.8 - 8.5 (-9.5) × (4.8-) 5.0 - 6.5 (-7.5) μm, with Q = (1.21-) 1.34 - 1.49.......................... *Amanita flavoconia* var. *flavoconia.*

4. Pileus some shade of brown or gray or umber.

5. Lacking distinctive odor; known from Europe, but claimed for region of study; spores (Jenkins, 1986) 8.6 - 10.1 × 7.3 - 8.9 μm, with Q = 1.18..... *Amanita excelsa.*

[Not confirmed for North America.]

5. Having distinctive odor, often described as like fruit or anise; spores (7.0-) 7.5 - 9.8 (-10.5) × (4.5-) 4.9 - 6.8 (-7.5) μm, with Q = 1.42 - 1.56.......... *Amanita species 18.*

54. *AMANITA FLAVOCONIA* Atk. var. *FLAVOCONIA* (14, 16, 24, 25, 41, 42)

This very common, colorful mushroom is small to medium sized and has a bright yellow to orange pileus with a nonstriate margin. Its stipe, annulus and the edges of the lamellae are often yellow. The universal veil is almost always yellow (very rarely white, occasionally yellowish orange) and easily lost from both the pileus and the bulb. It is often confused with *A. frostiana* (see above). *Amanita flavoconia* is found in beech-oak-hickory forests, under hemlock, and in small spruce bogs. Bills *et al.* (1986) reported this entity as very common in red spruce forests, but not present in northern hardwood forests.

SP: [110/6/6] (6.5-) 6.8 - 8.5 (-9.5) × (4.8-) 5.0 - 6.5 (-7.5) μm; **L** = (7.2 -) 7.5 - 8.1 μm; **L'** = 7.7 μm; **W** = 5.3 - 6.1 μm; **W'** = 5.7 μm; Q = (1.08-) 1.17 - 1.54 (-1.64); **Q** = (1.21-) 1.34 - 1.49; **Q'** = 1.36.

CE: WV—Greenbrier Co. - Monongahela Nat. For., Lk. Sherwood, M. H. & R. E. Tulloss 9-2-82-B. Tucker Co. - Fernow Exp. For., 4.ix.1992 S. L. Stephenson, R. P. Bhatt & A. Kumar WS7-103 (FWVA), WS13-104 (FWVA), WS13-105 (FWVA), WS13-106 (FWVA), and WS13-139 (FWVA).

55. *AMANITA FLAVORUBESCENS* Atk. (12, 16, 25)

This mushroom is medium to large and has a yellow to sordid yellow to brownish yellow pileus with yellow volval warts. In mature material, the context of the stipe base will be found to be stained wine red or reddish brown. The stipe is annulate and often has yellow tints. The volva at the stipe base is yellow, friable, and often lost in collecting. Occasionally, the pileus will be bruised during expansion and be a deep wine red rather than yellow. *Amanita flavorubescens* is found in association with oak.

SP: 9.37 - 10.15 × 6.25 - 7.05 μm; **Q** = 1.42.

CE: No collection retained from region of study.

56. *AMANITA RUBESCENS* var. *RUBESCENS sensu auct. amer.* (7, 16, 24, 25, 42, 43)

This mushroom is medium to large. It has a yellowish cream to pale tan to brassy to brownish pileus that stains wine red to reddish brown slowly, as do all portions of the fruiting body. The stipe is pallid at first with a membranous annulus (sometimes pale yellowish on the underside) and a basal bulb. Volval material is pallid at first (somewhat yellowish near the pileus margin in some buttons), but darkens on exposure; it may be present on the pileus as warts; at the stipe base, it is sufficiently friable to be lost during collection quite frequently. *Amanita rubescens sensu auct. amer.* will cause stomach upset if ingested raw. It is often found in association with oak and in dry oak-pine forests.

SP: (7.0-) 7.3 - 9.5 (-9.8) × (5.6-) 5.9 - 7.0 (-7.3) μm; **Q** = 1.23 - 1.38.

CE: No sufficiently documented collection available from region of study.

57. *AMANITA RUBESCENS* var. *ALBA* Coker (16)

This mushroom is very like *A. rubescens sensu auct. amer.* (above) except that, before the oxidation reaction is notable, the fruiting body is entirely white (with the occasional exception of a yellowish tint sometimes seen on the underside of the annulus). *Amanita rubescens* var. *alba* has been said to occur on the West Coast of the U.S.; however, the western entity is a separate species—*A. novinupta* Tulloss and Lindgren (1994). *Amanita rubescens* var. *alba* will cause stomach upset if ingested raw. This entity is often found in association with oak and in dry oak-pine forests.

SP: (6.5-) 7.0 - 9.8 (-10.5) × (4.5-) 5.0 - 7.0 (-8.5) μm; **Q** = 1.34 - 1.49 (-1.50).

CE: No collection retained from region of study.

58. *AMANITA SPECIES 18* (16)

This mushroom may be identical to *A. submaculata* Peck; it is very slender, has a fruit-like odor and gray-brown pileus pigment in radial "fibrils." The stipe has a large, flaring, membranous annulus. The remains of the universal veil at the top of the bulb is sometimes found as a slight, appressed limb. Occasionally, one sees brick-red staining in old wounds. This entity may be found in deciduous forests and in dry oak-pine forests.

SP: [86/3/3] (7.0-) 7.5 - 9.8 (-10.5) × (4.5-) 4.9 - 6.8 (-7.5) μm; **L** = 8.2 - 8.6 μm; **L'** = 8.5 μm; **W** = 5.5 - 6.2 μm; **W'** = 5.7 μm; Q = (1.18-) 1.31 - 1.71 (-2.02); **Q** = 1.42 - 1.56; **Q'** = 1.50.

CE: KY—Laurel Co. - Levi Jackson Wilderness Trail St. Pk., D. C. & R. E. Tulloss 7-20-87-B. WV—Greenbrier Co. - Monongahela Nat. For., Lk. Sherwood, M. H. & R. E. Tulloss 9-2-82-A. Tucker Co. - Fernow Exp. For., 4.ix.1992 S. L. Stephenson, R. P. Bhatt & A. Kumar WS13-110 (FWVA).

s. *AMANITA EXCELSA* (Fr.) Bertillon *in* DeChambre (18, 24)

This species is somewhat variable, having both a slender and a squat habit. The pileus is brownish gray. It is not clear to us that this European entity actually occurs in the U.S. **SP**: 8.6 - 10.1 × 7.3 - 8.9 μm; **Q** = 1.18.

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MYCOTAXON

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AMANITA MURINOFLAMMEUM—A NEW SPECIES FROM DRY FORESTS OF EASTERN AUSTRALIA

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Summary

Amanita murinoflammeum is described as new from eastern Australia.

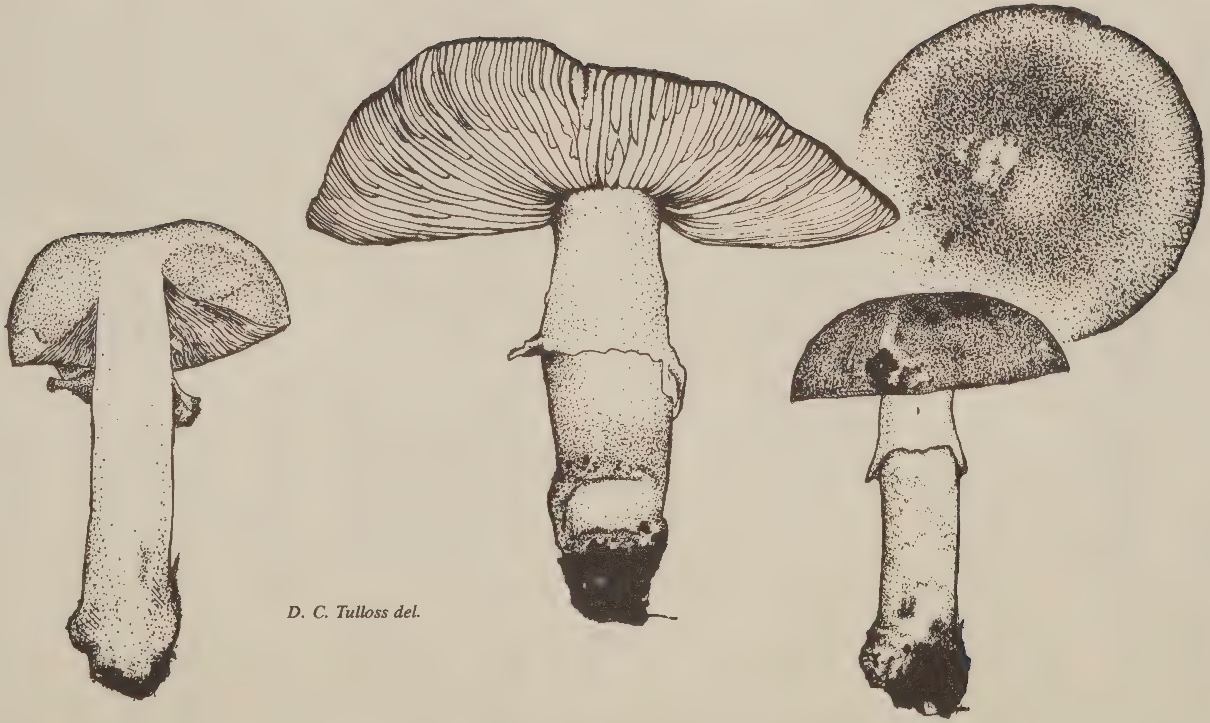
Methodology and notation follow those of Tulloss *et al.* (1992) as modified by Tulloss (1993; 1994). Color codes of the form "6D6" are from (Kornerup & Wanscher, 1978). Color names in italic type with the first letter capitalized are from Ridgway (1912). Translations of Ridgway color names to the Munsell color code follow Hamly (1949). "CSIRO" is the acronym for the Commonwealth Scientific and Industrial Research Organization. Herbarium codes used follow Holmgren *et al.* (1990) except in the cases of our personal herbaria:

RET - private herbarium of R. E. Tulloss
YOUNG - private herbarium of A. M. Young.

Amanita murinoflammeum Tulloss, Young & Wood *sp. nov.*

Etymology: *murinus*, mouse gray + *flammeum*, a bridal veil; because of the unusual partial veil—a feature apparently quite rare in those species in *Amanita* section *Vaginatae* with friable to submembranous universal veils.

Pileus 85 - 140 *mm latus, initio rubro-brunneus et convexus disco complanato, deinde pallido-brunneus et subplanus margine decurvata, carne rubro-brunnea infra pileipellem (cetera alba), margine brevi-striata et nonappendiculata, velo universali*



D. C. Tulloss del.

Fig. 1 *Amanita murinoflammeum* (holotype). Habit (0.6×).

detersili subalbido vel pallido-griseo vel griseo (ubi veto) et fragmenta vel verrucas irregulares formans. Lamellae liberae vel annexae, confertae, initio pallido-flavae vel subcremeae deinde subalbidae; lamellulae truncatae. Stipes 80 - 110 × 15 - 30 *mm, albus, velo hymeniale membranaceo vel submembranaceo vel coacto (initio albo margine grisea, ubi veto brunneo-griseo) collabens, velo universali submembranaceo initio subalbido deinde griseo et annulum vel limbum brevem a basi stipitis disjunctum formans. Sporae* (9.8-) 10.5 - 13.2 (-16.5) × (7.0-) 8.2 - 11.0 (-14.8) *μm. Fibulae praesentes. Habitat Eucalypto, in sylvis sclerophyllis. Holotypus*: AUSTRALIA, Queensland, Nanango Shire, Blackbutt, 5.i.1991 A. M. Young 1601 (BRIP 17362).

Amanita murinoflammeum is a medium-sized to large, often robust species of *Amanita* section *Vaginatae* (Fr.) Quél. (Corner & Bas, 1962) having a reddish brown to light brown pileus with occasional white, irregular warts or patches of the universal veil that become grayish over time. Its bulbless stipe is white with pale rosy tints especially near the apex and is decorated with a rather large, graying annulus and with remnants of the graying, submembranous, universal veil in broken rings or patches or as a shallow, coherent limb (but not a sac) on the lower portion (but not the very base) of the stipe.

PILEUS: 85 - 140 mm wide, light reddish brown [8D3, near *Drab* (10YR 5.5/3.0)] when young, becoming light brown (6D4) when expanded, virgate (10× lens), at first subhemispheric to convex (often with flattened disc), becoming nearly planar with decurved margin, slightly viscid when moist; *pileipellis* peeling rather easily up to two-thirds of distance from margin to center of disc (even in exsiccata); *context* mostly white, reddish brown just below pileipellis, 10 - 11.5 mm thick at stipe, thinning evenly to margin, not changing color when cut or bruised; *margin* short striate (0.15R), nonappendiculate; *universal veil* absent or present as whitish to pale gray warts, becoming darker gray with age, irregular, at times confluent over disc.

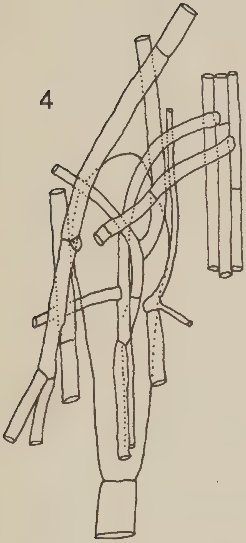
LAMELLAE: free to adnexed with decurrent line on apex of stipe, close, off-white with faint yellow or cream tint at first, somewhat sordid pale tan (5B5) or darker in exsiccata, with edges white and finely fimbriate (10× lens); *lamellulae* truncate to rounded truncate, plentiful, of varying length, between every pair of lamellae in some basidiocarps.

STIPE: 80 - 110 × 15 - 30 mm, cylindric or slightly narrowing upward or broadest at midpoint, white, with rosy tints (especially near apex), often striate for 20 mm or more at apex; *context* white, unchanging when cut or bruised, stuffed becoming more or less hollow, central cylinder 4.5± mm wide; *partial veil* membranous to submembranous or felted, skirt-like, superior to submedian to subinferior, at first white and striate on upper surface with narrow gray line around edge and gray on under surface, eventually collapsing on stipe and becoming brownish gray on upper surface from edge inward; *universal veil* on stipe base, submembranous, whitish, becoming gray at maturity, disposed as one or more flaring short limbs (not part of sac and some distance from stipe base) or like inverted inferior annulus or as isolated patches or in incomplete ring on lower stipe, rather friable, distance from stipe base to top of highest patch or limb 28 - 43 mm, with *limbus internus* not discernible.

Odor and *taste* not recorded.

MACROCHEMICAL TESTS: none recorded.

PILEIPELLIS: 25 - 50 μm thick, yellow brown except for gelatinized surface, color continuing somewhat into pileus context; filamentous, undifferentiated hyphae 1.8 - 8.8 μm wide, branching, dominantly subradially arranged, interwoven, partially to totally gelatinizing only at surface, with intracellular pigment; vascular hyphae 2.5 - 10.0 μm wide, common to plentiful in and just below gelatinized region, not themselves gelatinized, locally tangled in knots, often coiled like overstretched springs, occasionally branching, with plentiful number radially arranged, but with many others criss-crossing. PILEUS CONTEXT: filamentous, undifferentiated hyphae 2.0 - 15.5 μm wide, loosely interwoven, often fasciculate; acrophysalides plentiful, thin-walled, fusiform-elliptical to clavate to broadly ellipsoid to subpyriform, to 101 × 53 μm; chains of slightly inflated cells with constrictions at septa occurring near attachment of lamellae and such cells occasionally with small side branch; vascular hyphae 2.0 - 6.5 μm wide, branching. LAMELLA TRAMA: bilateral; central stratum relatively narrow [w_{cs} = 35 - 50 μm (good rehydration)]; angle of divergence of inflated cells of subhymenial base often shallow at first, around 10° - 30°, and then curving so that elements approach subhymenium at angle of about 60° to central stratum; filamentous, undifferentiated hyphae 1.5 - 11.5 μm wide, branching; divergent, terminal inflated cells not observed; inflated cells of subhymenial base subglobose to ellipsoid to clavate to fusiform to allantoid (up to 55 × 32 μm), thin-walled, with single cell infrequently reaching from central stratum to base of basidia; vascular hyphae 7.0 - 10.2 μm wide, not common. SUBHYMENIUM: w_{st}-near = 55 - 65 μm (very good rehydration); w_{st}-far = 70 - 90 μm (very good rehydration); with basidia arising from uninflated or barely inflated hyphal segments or (occasionally) from small inflated cells, with elements arranged in occasionally branching structure, sometimes seeming pseudoparenchymatous at low magnification, with longest axes of elements becoming perpendicular to central stratum one or two hyphal segments from base of connected basidium; clamps relatively common and easily seen. BASIDIA: 47 - 80 × (4.2-) 9.5 - 16.5 μm, thin-walled, dominantly 4-, but also 1- and 2-sterigmate, with sterigmata $5.0^{\pm} \times 1.8^{\pm}$ μm; clamps common, prominent. UNIVERSAL VEIL: *On pileus, base of wart*: filamentous, undifferentiated hyphae 1.8 - 10.0 μm wide, frequently branching, dominant, in fascicles or not, some elements partially gelatinized, with walls slightly thickened, often with yellowish walls; inflated cells scattered, locally in clusters, often sordid to brown tinted, terminal, singly or in short chains, cylindric to fusiform to clavate (up to 95 × 25 μm) or ellipsoid to ovoid to subglobose (up to 62 × 45 μm), with walls slightly thickened or up to 0.8 μm thick; vascular hyphae 3.0 - 11.0 μm wide, plentiful to locally dominant, branching; clamps plentiful, prominent. *On lower stipe, exterior surface*: gelatinized and yellow-orange at surface; filamentous, undifferentiated hyphae 2.1 - 10.5 μm wide, branching, many longitudinally oriented, often in fascicles; inflated cells scarce, elongate to ellipsoid to subglobose, up to 52 × 50 μm, with walls up to 1.4 μm thick; vascular hyphae 2.1 - 4.6



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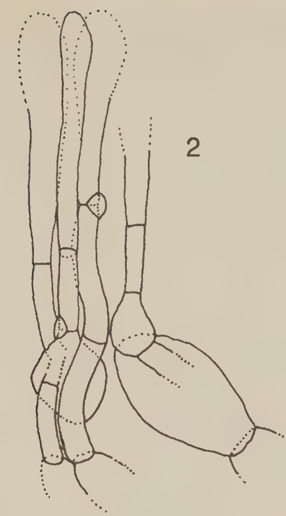

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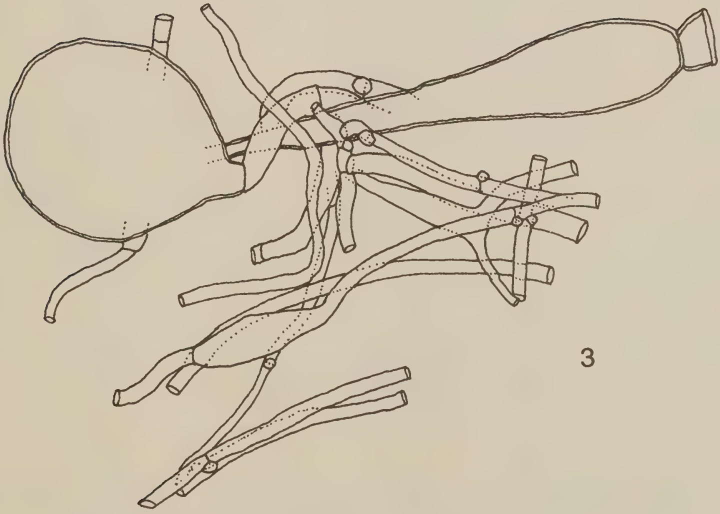

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Scale for anatomical figures is 645:1. Figs. 2-4 *Amanita murinoflammeum* (holotype). Fig. 2. Elements of hymenium and subhymenium . Fig. 3. Universal veil elements—in region with some inflated cells. Fig. 4. Elements of partial veil.

μm wide, uncommon, occasionally in knots locally; clamps plentiful. *At stipe base, interior*: filamentous, undifferentiated hyphae 1.2 - 12.6 μm wide, plentiful to locally dominant, branching, occasionally with yellowish subrefractive walls, sometimes in fascicles (loosely to quite densely interwoven), with those of greater diameter having thicker walls (up to 0.7 μm thick); inflated cells scattered, locally clustered (and then locally dominant), with walls thin or up to 0.8 μm thick, most frequently terminal singly, also in short terminal chains, usually hyaline, occasionally with distinct brown tint, subglobose to subpyriform to ovoid to ellipsoid to broadly fusiform to broadly clavate to narrowly clavate, up to 97 × 78 μm, on occasion as subventricose swelling within intercalary hyphal segment (*e.g.*, 38 μm wide swelling in segment 7.7 μm wide at and near its ends); vascular hyphae 2.2 - 4.8 μm wide, branching infrequently, slightly sordid yellow, scarce; clamps plentiful, prominent. *At stipe base, inner surface*: denser than interior and with larger proportion of filamentous, undifferentiated hyphae (largely sublongitudinally oriented), partially to extensively gelatinized. STIPE CONTEXT: longitudinally acrophysalidic; filamentous, undifferentiated hyphae 2.0 - 11.9 μm wide, branching, rather large number of side branches not longitudinally oriented, with walls up to 0.8 μm thick; acrophysalides dominant, fusiform-elliptic to ventricose-rostrate to narrowly clavate to narrowly ovoid, terminal or in terminal chains (with constricted intervening septa) of up to three cells, up to 292 × 63 μm, with walls 0.8 - 1.4 μm thick; vascular hyphae 4.2 - 10.5 μm wide, branching, scattered, scarce in some mounts; clamps common, on hyphae of widely varying diameter. PARTIAL VEIL: filamentous, undifferentiated hyphae 1.2 - 7.2 μm wide, dominant, with most radially oriented, branching, occasionally anastomosing, sometimes with slightly inflated intercalary segments, with walls up to 0.5 μm thick; inflated cells terminal, narrowly clavate to clavate, up to 71 × 21 μm, with walls thin or up to 0.8 μm thick; vascular hyphae 1.0 - 4.0 μm wide, infrequent; clamps plentiful, yellowish when on yellowish-walled hyphae.

BASIDIOSPORES: [121/6/2] (9.8-) 10.5 - 13.2 (-16.5) × (7.0-) 8.2 - 11.0 (-14.8) μm, (**L** = 11.4 - 12.6 μm; **L'** = 11.9 μm; **W** = 8.4 - 10.2 μm; **W'** = 9.3 μm; Q = (1.10-) 1.15 - 1.47 (-1.65); **Q** = 1.21 - 1.43; **Q'** = 1.29), hyaline, thin-walled, smooth, inamyloid, broadly ellipsoid to ellipsoid, occasionally subglobose, often at least somewhat adaxially flattened (especially when Q of spore above **Q'**); apiculus sublateral, truncate-conic, relatively prominent; contents monoguttulate; white in deposit.

Habitat and distribution: Australian Capital Territory: March, scattered on semi-shaded ground in severely disturbed, dry, sclerophyll forest on gentle slope with *Eucalyptus mannifera* Mudie, *E. polyanthemos* Schaer., *Bursaria spinosa* Cav., and *Acacia dealbata* Link. Queensland: January, scattered in short grass of open woodland under *Eucalyptus sp.*

Collections examined: **AUSTRALIA**: AUSTRALIAN CAPITAL TERRITORY—Canberra, btwn. Australian Nat. Bot. Gardens and CSIRO, 24.iii.1992 H. Streimann 49379 (CBG (*n.v.*); NY; TAA (*n.v.*)). QUEENSLAND—Nanango Shire - Blackbutt, 5.i.1991 A. M. Young 1601 (holotype, BRIP 17362; isotypes, YOUNG & RET).

DISCUSSION

The only previously described Australian species that might be assignable to *Amanita* section *Vaginatae* and combines an annulus, limbate or saccate volva, and spores of approximately the size and shape of those in the cited collections is *A. cinereo-annulosa* Clel. {South Australia, Encounter Bay, 26.v.1932 J. B. Cleland *s.n.* (lectotype, AD 3010 & 3011 [formerly ADW 9270])}. The lectotype was designated by Reid (1980) without comment. Based on the descriptions of Cleland (1933; 1934) and Tulloss' examination of the lectotype (unpub. data), *A. cinereo-annulosa* has the following characters differentiating it from *A. murinoflammeum*:

- a *Drab* to paler than *Drab* pileus
- a *Drab*, superior annulus rather distant from the stipe apex
- a stipe inserted to about one-third its length in the substrate and (according to the protologue) having a slightly bulbous base (which, if proven true by further observation, could place the species in *Amanita* section *Amanita*)
- an ample, sheathing, limbate volva of uniform height somewhat suggestive of that of *A. pantherina* (DC.:Fr.) Krombh.
- a universal veil that, in exsiccata of the lectotype, is gray only on the surface of a very thin, very broad patch over the disc of one specimen
- a universal veil containing no thick-walled elements and having scattered, narrowly clavate cells as its only inflated elements
- spores [114/6/1] (9.3-) 9.8 - 14.7 (-20.3) × (5.6-) 6.4 - 8.6 (-10.2) μm, (**L** = 11.2 - 12.3 (-13.7) μm; **L'** = 12.2 μm; **W** = 7.1 - 7.6 μm; **W'** = 7.4 μm; Q = (1.33-) 1.40 - 1.99 (-2.23); **Q** = 1.58 - 1.66 (-1.83); **Q'** = 1.66).

The literature was examined with regard to non-Australian species with spore size and shape similar to those of *A. murinoflammeum*; an annulate stipe; and a submembranous or membranous, graying universal veil. While Tulloss has collected material in the U.S.A. that falls into this category, apparently no such taxon has been published.

In addition to having a partial veil, *A. murinoflammeum* is somewhat unusual in that many of the taxa in *Amanita* section *Vaginatae* that have a graying, collapsing universal veil have a stipe central cylinder with a diameter that is large relative to the width of the stipe (ratio of 0.45 to 0.55 or more)—resulting in a rather fragile stipe. In *A. murinoflammeum*, the ratio of the diameter of the stipe central cylinder to the stipe width ranges from 0.25 to 0.35.

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A SYNOPSIS OF THE LECANORA SUBCARNEA GROUP

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Abstract: The saxicolous *Lecanora* species related to *L. subcarnea* are revised. Descriptions of the species and a key to the taxa are included. Five species (*L. farinacea, L. ochroidea, L. rhodi, L. sanctae-helenae* and *L. subcarnea* with two chemotypes) and one variety (*L. subcarnea* var. *soralifera*) are accepted. *L. albidorufa, L. blanda, L. claudestina, L. dasycarpa, L. dirinaeformis, L. flexuosa, L. pruinata, L. rubrocincta, L. subglaucodea* and *L. subpallida* and *Lecidea myoplaca* are reduced to synonymy with *L. farinacea*, *L. trevisanii* and *Lichen flexuosus* with *L. subcarnea*. Neotypes for *L. ochroidea* and *L. subcarnea* are selected.

The *Lecanora subcarnea* group is well known to lichenologists and distributed world-wide. *Lecanora subcarnea* itself is a rather common lichen in Europe. Despite this fact, the taxonomy and nomenclature of the group is not well known. The difficulty in defining species in this group has been recognized by Th. Fries (1871) and, more recently, by Nimis & Poelt (1987). The *L. subcarnea* group is defined here as comprising taxa which have heavily pruinose apothecial discs which do not contain chromones. All species occur on siliceous rocks. They may have an indistinct amphithecial cortex, but in most species a cortex is lacking.

The members of the group are closely related to the *Lecanora "pallida"* (=*albella*) group, which has been studied by Imshaug & Brodo (1966), but the taxa of the *pallida* group occur mainly on bark. The two groups are considered as separate in this paper for practical reasons only. They form a natural group, which is closely related to the *Lecanora rupicola* group, recently monographed for Europe by Leuckert & Poelt (1989). The *L. rupicola* group mainly differs in containing chromones in the epihymenium and the common occurrence of chloroxanthones. A further group of species with heavily pruinose discs includes *L. carpinea* (also treated by Imshaug & Brodo 1966) and related species. These species have a distinct amphithecial cortex and contain chromones in the epihymenium.

As a part of a continuing investigation of the Australian species of *Lecanora* Ach., the saxicolous species with pruinose, apothecial discs lacking chromones, were examined. It soon became clear that an examination of species described from other continents was necessary to clarify the nomenclature and systematics of that group. Therefore type material of all species belonging to this group were studied as well as additional material when this was available. Since the circumscription of taxa in this group were rather poorly defined and several nomenclatural problems were involved, we decided to include our results on the non-Australian species as well in this synopsis. This treatment cannot be regarded as a monograph of the taxa, but a preliminary attempt to clarify the taxonomy and nomenclature of the species involved.

Material and Methods

Material. Specimens were studied from the following herbaria: BM, BRI, CANL, CBG, CHR, COLO, ESS, G, GZU, H, H-ACH, H-NYL, HO, M, O, OTA, PC, PC-FÉE, PERTH, PRE, S, TUR, UPS, W, ZT and the private herbaria of André Aptroot (Baarn), Klaus Kalb (Neumarkt/Opf.) and H.Thorsten Lumbsch (Essen).

Methods. Microscopy. Thalli and apothecia were cut using a freezing microtome in 16-20 μm thickness and stained with lactophenol cottonblue.

Chemistry. The chemical constituents were identified using thin layer chromatography, TLC (Culberson 1972, Culberson et al. 1981, Culberson & Johnson 1982) and gradient-elution high performance liquid chromatography, HPLC (Feige et al. 1993).

Morphology

Thalli. All members of the *Lecanora subcarnea* group are crustose lichens, which occur on siliceous rocks. The thalli vary from thick to thin, continuous to rimose-areolate (as in some morphotypes of *L. farinacea*) or rimose- to verrucose-areolate as is observed in most species. The areolae vary from plane to bullate. The thalli are mostly greyish although the colour may vary from whitish-grey to yellowish-grey, and sometimes greenish-grey or even rusty-brown (in *L. farinacea*). Prothalli are either lacking or whitish. The only form of vegetative propagules present in the group are soredia (in *L. subcarnea* var. *soralifera*).

Apothecia. Apothecia are found frequently in most specimens of the group. In most taxa they are sessile, sometimes adnate (e.g. *L. farinacea*), but other species may have fruiting bodies which are constricted at the base (e.g. *L. rhodi*). The discs are plane to convex and always heavily pruinose. The colour of the discs vary from carneous to pinkish, but can be also reddish-orange (e.g. *L. rhodi*). When infected by lichenicolous fungi, the discs may become dark brown in colour.

The apothecial margins are concolorous with the thallus. In most species they are prominent and persistent, but in *L. rhodi* the margins become excluded. In several specimens heavily flexuose margins can be seen, while others have entire to flexuose discs. In *L. sanctae-helenae* the margins remain rather thick and entire and never become flexuose.

Anatomy

Thalli. The internal morphology of the thallus is very uniform within the group and is typical of that observed in *Lecanora* s.str. An epinecral layer covering the thallus, an algal layer and the medulla can be distinguished.

Apothecia. The apothecial margin is composed of the amphi- and parathecium. The amphithecium contains trebouxioid algae and is rather thick (up to 270 μm basally) and filled with small crystals, which rapidly or slowly dissolve in KOH. These crystals are prominent under polarized light (POL+). An amphithecial cortex is absent in most species, but an indistinct cortex is observed in *L. farinacea* and *L. sanctae-helenae.* If present, the cortex is rather thin (25-35 μm) and interspersed with small crystals (POL+), which may or may not dissolve in KOH. The parathecium always contains small crystals (POL+) and is 15-20 μm thick.

Under the microscope the epihymenium appears granular with small greyish to brownish crystals (POL+). These crystals and their colouration disappear in KOH. Both the hymenium and the hypothecium are hyaline. The paraphyses are septate, sparsely branched and slightly thickened apically. The subhymenium may be hyaline or yellowish. Clavate to clavate-cylindrical, eight-spored asci occur in this group as is the typical of asci in *Lecanora* s.str. (cf. Hafellner 1984, Hertel & Rambold 1985). The ascospores are always hyaline, non-septate and ellipsoid to broadly ellipsoid.

Tab. 1: Chromatographic data for the substances present in the *Lecanora subcarnea* group (RF and RI values x 100; Colours of substances after spraying with sulfuric acid). Data are from the WINTABOLITES-database (Mietzsch et al. 1993).

Substance	RF (A)	RF (B')	RF (C)	Colour in visible light	Colour under UV	RI (HPLC)
Atranorin	75	73	79	Orange	Orange	38
Chloroatranorin	74	73	81	Orange	Orange	42
Connorstictic acid	11	11	3	Orange	Orange	3
Conprotocetraric acid	2	2	2	Orange	Brown	12
2'-*O*-methylperlatolic acid	52	48	53	Yellow	Green	39
Norstictic acid	40	32	30	Yellow	Yellow	12
Placodiolic acid	65	60	67	Orange	Purple	27
Protocetraric acid	3	19	5	Grey	Purple	13
Salazinic acid	10	7	4	Orange	Orange	5
Virensic acid	26	56	40	Brown	Brown	26

Chemistry

While the morphology and anatomy of the *L. subcarnea* group is not very variable, chemistry plays an important role in the definition of taxa. Most chemical segregates can also be distinguished by morphological and anatomical characters, but these may be subtle or difficult to observe, if one is not familiar with the taxa. Therefore chemical analysis is an ideal tool for the identification of species in the *L. subcarnea* group.

Tab. 2: Chemical patterns of taxa in the *Lecanora subcarnea* group (only major substances mentioned: 1=atranorin; 2=2'-*O*-methylperlatolic acid; 3=norstictic acid; 4=placodiolic acid; 5=protocetraric acid; 6=virensic acid).

Taxon	1	2	3	4	5	6
L. farinacea	+		±		±	
L. ochroidea	+		+			
L. rhodi	+	+	+			
L. sanctae-helenae	+		+	+	+	
L. subcarnea chemical race I	+				+	
L. subcarnea chemical race II	+					+
L. subcarnea var. *soralifera*	+				+	

Lichen substances occurring in the Lecanora subcarnea *group.* An overview of the substances present in *L. subcarnea* and related species and their chromatographic properties is given in Tab. 1. Most substances occurring in the group are β-orcinol depsidones, including connorstictic, conprotocetraric, norstictic, protocetraric, salazinic and virensic acids. One or several β-orcinol depsidones occur in all members of the group, the combination of compounds and their abundance differs between the taxa. The β-orcinol depsides atranorin and chloroatranorin, however, are present in every species. Two further lichen substances were detected in the group and both are characteristic of individual species. The orcinol depside 2'-*O*-methylperlatolic acid occurs only in *L. rhodi*, while *L. sanctae-helenae* is characterized by the presence of the dibenzofuran placodiolic acid. The distribution of the major chemical substances observed in the group is presented in Tab. 2.

Key to the species

1 a - Thallus sorediate.......................*L. subcarnea* var. *soralifera* H. Magn.
1 b - Thallus without soredia..2
  2 a - Amphithecial cortex present..3
  2 b - Amphithecial cortex absent...4
3 a - Placodiolic acid present, apothecial margins thick entire........*L. sanctae-helenae* Müll. Arg.
3 b - Placodiolic acid absent, apothecial margins thin, entire to flexuose......*L. farinacea* Fée
  4 a - Thallus and apothecia K + yellow, containing protocetraric acid, norstictic acid lacking.........................*L. subcarnea* (Lilj.) Ach.
  4 b - Thallus and apothecia K + yellow, becoming red, containing norstictic acid, protocetraric acid lacking...................................5
5 a - Apothecial discs reddish-orange, apothecia sessile to constricted at base, 2'-*O*-methylperlatolic acid present.............................*L. rhodi* Szatala
5 b - Apothecial discs carneous to pinkish, apothecia sessile, 2'-*O*-methylperlatolic acid absent.......................................*L. ochroidea* (Ach.) Nyl.

The species

1. Lecanora farinacea Fée

Essai Crypt.: 117 (1824). - Type: "Ad corticem Cinchonarum" (G - holotype).

Syn: *Lecanora albidorufa* Zahlbr., Denkschr. Akad. Wiss. Wien, math.-naturw. Kl. **104:** 340 (1941). - Type: New Zealand, near Kyeburn, *J.S. Thomson 2391* (CHR, OTA-isotypes).

Lecanora blanda Nyl., Ann. Sci. Nat. Bot., ser. 4, **11:** 219 (1859). - Type: Peru, Prov. Carabaya, Quiaca, *Weddell* (H-NYL 27065-holotype).

Lecanora claudestina Fée, Bull. Soc. Bot. Fr. **20:** 313 (1873). - Type: Brazil, Rio de Janeiro, *Glaziou 5116* (PC-FÉE-lectotype here selected; PC-FÉE-isolectotype).

Lecanora dasycarpa Zahlbr., Denkschr. Akad. Wiss. Wien, math.-naturw. Kl.

104: 341 (1941). - Type: New Zealand, Abbot's Hill, near Dunedin, 300 m, *J.S. Thomson ZA 559* (CHR, OTA-isotypes).

Lecanora dirinaeformis Massal., Mem. I.R. Istit. Veneto **5:** 57 (1861). - Type: "Cap. bon. Sp.", 1857-58, *Wawra* (M-isotype).

Lecanora flexuosa Stizenb., Ber. Thätigk. St. Gall. naturw. Ges. **1888/89**: 219 (1890). - Type: South Africa, Transvaal, Duivels Knackler near Lydenburg, *Wilms* (ZT-holotype).

Lecanora pruinata Krempelh., Flora **59:** 143 (1876), nom. nov. pro *Lecanora albescens* Fée, Bull. Soc. Bot. Fr. **20:** 313 (1873), non (Hoffm.) Branth & Rostr. - Type: Brazil, Rio de Janeiro, *Glaziou 3486* (PC-FÉE-holotype; UPS-isotype).

Lecanora rubrocincta Stirton, Proc. Phil. Soc. Glasgow **10:** 295 (1877). - Type: New Zealand, near Wellington, *J. Buchanan* (BM-isotype).

Lecanora subglaucodea (Krempelh.) Zahlbr., Denkschr. Akad. Wiss. Wien, math.-naturw. Kl. **104:** 342 (1941). - *Lecidea subglaucodea* Krempelh., Verh. zool. bot. Ges. Wien **26:** 456 (1876). - Type: New Zealand, *C. Knight* (M-holotype).

Lecanora subpallida Knight, Trans. Linn. Soc. London, ser. 2, **2:** 48 (1882). - Type: Australia, NSW, *C. Knight* (M-isotype).

Lecidea myoplaca Zahlbr., New Zealand, Otago, Horse Range near Dunback, *J.S. Thomson 1428* (OTA-29441-lectotype, here selected).

Further synonyms are listed by Galloway (1985), but we did not examine this material.

(Fig. 1A & B)

Thallus crustose, uniform, adnate, thick to thin, sometimes farinaceous, rimose-areolate or continuous to verrucose-areolate, greyish white to creamish, sometimes rusty brown to whitish, with or without whitish pruina, soredia absent, prothallus whitish or lacking.

Apothecia adnate to sessile, 0.2-2.5 mm in diam., discs carneous to pinkish, heavily whitish grey pruinose, plane to convex, margins prominent, persistent, smooth, entire or flexuose, concolorous with thallus. Cortex inspersed with small crystals which are insoluble in KOH, indistinct, 25-35 μm thick, amphithecium with numerous small crystals, slowly dissolving in KOH, parathecium with small crystals, ca. 20 μm thick, epihymenium granular with small crystals, grey-brown, 10-15 μm tall. Hymenium hyaline, 70-100 μm tall, subhymenium pale yellowish, paraphyses sparsely branched, apically slightly thickened. Asci clavate, 8-spored. Ascospores hyaline, non-septate, broadly ellipsoid, 12-15 x 7-11 μm.

Chemistry: Major substances: atranorin, ± norstictic and ± protocetraric acids; minor substances: chloroatranorin, connorstictic, ± norstictic, ± protocetraric and salazinic acids.

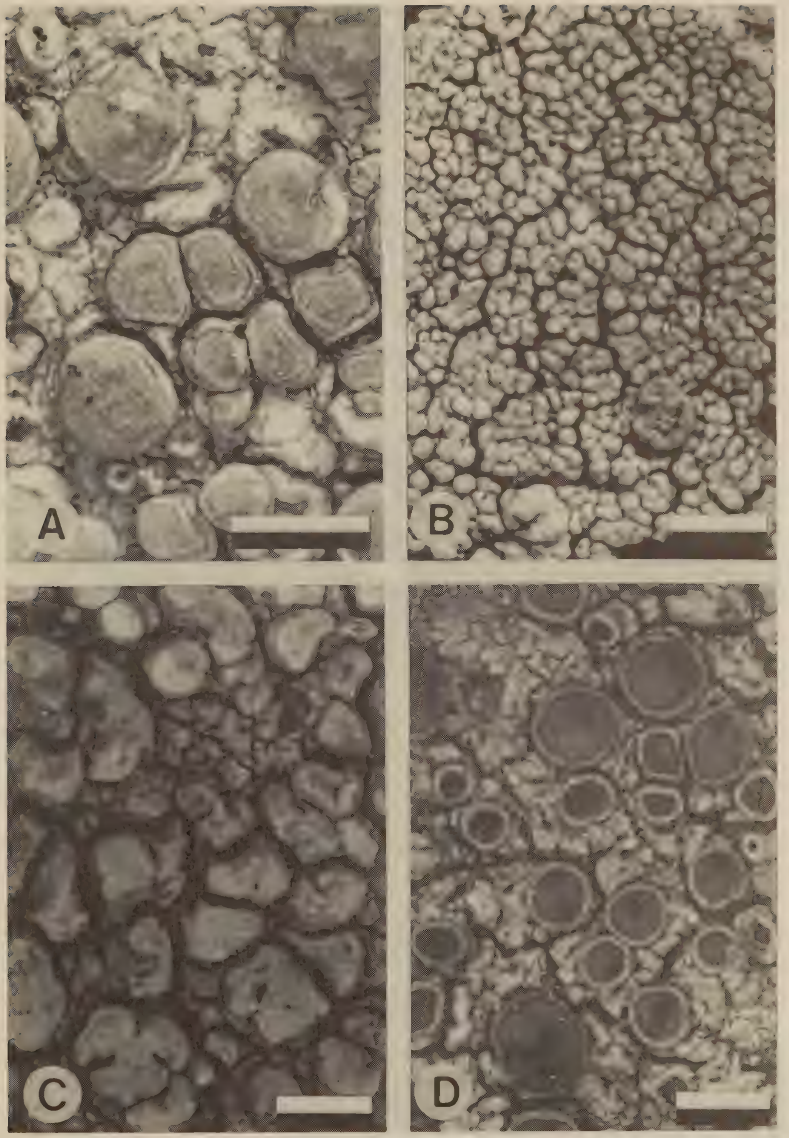


Fig. 1. A & B. *Lecanora farinacea*. A. *Brodo 24349* (CANL); B. Lectotype of *L. claudestina* (PC-FÉE). - C. *Lecanora ochroidea*, *Lundquist 8144* (UPS). - D. *Lecanora rhodi*, *Brodo 25533* (CANL). Scale = 1 mm.

Remarks: *Lecanora farinacea* is characterized by the whitish grey thallus, the presence of the norstictic acid chemosyndrome in addition to protocetraric acid and the relatively large spores. Moreover, it can be distinguished from most similar species by the presence of an amphithecial cortex where the cortical crystals do not dissolve in KOH.

Variability: This species is notorously variable, which is not surprising for such a widely distributed lichen. The number of synonyms listed above also reflects the fact that the species is both very common and variable. Regarding the morphology the thickness of the thallus can vary between rather thin to thick. The thickness of the pruina can also vary; in some specimens the pruina is rather thin (as in the types of *L. albidorufa* or *L. dasycarpa*, which are almost identical, although both taxa were described by Zahlbruckner in the same publication!), while others have very heavily pruinose discs.

The type of *L. claudestina* has a heavily verrucose thallus. This morphotype has also been collected in New Zealand [*Elix 7763* (CBG)] and seen by us in Australia, where it is typical for rather shaded habitats. While the morphology is rather variable, this species is quite uniform anatomically. Whereas atranorin and chloroatranorin are always present in this species, the concentration of the depsidones protocetraric and norstictic acids does vary. While both substances are major compounds in most specimens, in some either norstictic or protocetraric acids become minor compounds, while in a few cases one or other of the depsidones could not be detected. However, this morphological and chemical variation is interpreted as intraspecific variation, since no correlation with other characters or geography were found.

Taxonomy: *Lecanora farinacea* was listed as a synonym of *L. caesiorubella* (as "*L. cancriformis*") by Zahlbruckner (1928). However, Imshaug & Brodo (1966) demonstrated, that these species could be distinguished by their variation in spore size and ecology, among other characters.

The nomenclature of *L. caesiorubella* is somewhat puzzling. The first name mentioned in the literature for this common, subtropical and tropical, corticolous lichen was *Verrucaria cancriformis* Hoffmann (Hoffmann 1796). Following Degelius (1954), Imshaug & Brodo (1966) interpreted the description of the name *cancriformis* as a variety, because it was only mentioned by Hoffmann (1796: 171) in a note. However, this interpretation cannot be accepted because Hoffmann himself stated in a "Vorbericht" in his book, that taxa, which he did not accept, were mentioned in notes ["...auch Arten, welche ich als solche aufzuführen noch unentschloßen war, findet man entweder in Klammern () den Anmerkungen oder ohne Bezifferung der nächstverwandten Art beigestellt." (Hoffmann 1796)]. Since the name *cancriformis* was not accepted in the original publication, it has to be considered as not validly published by Hoffmann (1796) (Art. 34.1.). The misinterpretation of the valid publication, however, has no influences on the name to be used for the taxon. The correct name is *Lecanora caesiorubella* Ach.

Ecology and distribution: This species occurs on open to somewhat shaded siliceous rocks. It has a wide distribution in the Southern Hemisphere, occurring in southern Africa, South and Central America, Australia and New Zealand. In Australia it occurs in southwestern and eastern Australia, but is lacking in the dry inner part of the continent (Fig. 2). The lack of collections from NE Queensland is also notable.

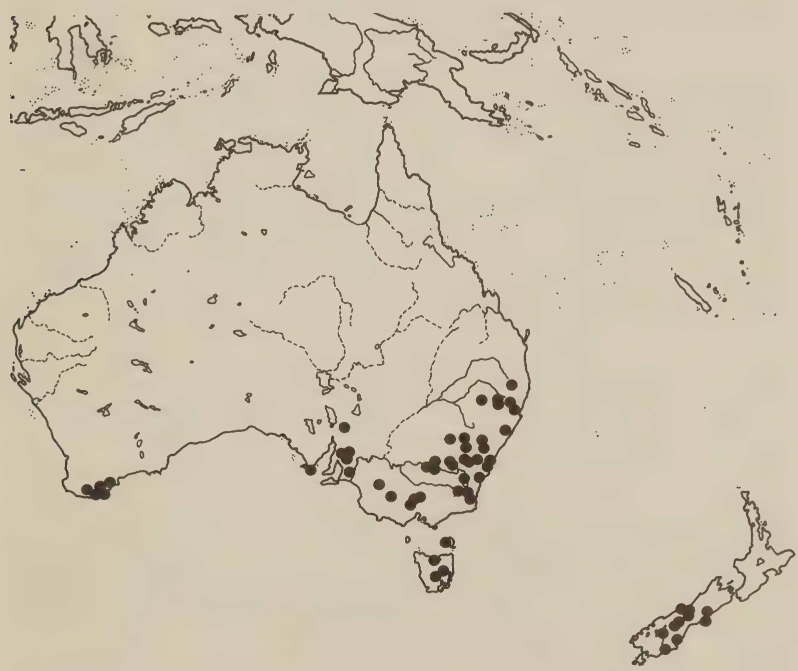


Fig. 2. Distribution of *Lecanora farinacea* in Australasia.

Selected specimens examined: **AUSTRALIA - Australian Capital Territory:** Black Mtn, 5 km NW of Canberra, 35°16'S, 149°06'E, 780 m, 15.6.1980, *H. Streimann 10302* (CBG). - Gudgenby River Gorge, 27 km S of Canberra, 35°37'S, 149°05'E, 700 m, 9.9.1987, *H. Streimann & H.T. Lumbsch 5629d* (hb. Lumbsch). - Molongo Gorge, 13 km E of Canberra, 35°20'S, 149°15'E, 650 m, 21.3.1976, *D. Verdon*

2153 (CBG). - **New South Wales:** Bemboka River Road, Glenbog State Forest, 15 km ESE of Nimmitabel, 36°33'S, 149°30'E, 1080 m, 1.4.1990, *H. Streimann 43869* (CBG). - Blue Mtns National Park near Glenbrook, c. 60 km west of Sydney, 9/1981, *M. Mayrhofer 3271* (GZU). - Braidwood District, Pigeon House Range between Nerriga and Sassafras, 1.10.1967, *W.A. Weber & D. McVean* (COLO-49039). - 11 km N of Glen Innes, near New England Hwy, 29°40'S, 151°46'E, 1000 m, 15.5.1987, *R.W. Rogers 8706* (BRI-491499). - Teudts Hill, 5 km SW of Bundanoon, 680 m, 17.9.1980, *J.A. Elix 8972* (CBG). - **South Australia:** Barossa Range, Menglers Hill, 4 km E of Tanunda, 27.10.1981, *J.A. Elix 9213* (CBG). - 10 km NE Eden Valley along the Keyneton Road, 487 m, 21.5.1976, *J.A. Elix 2264* (CBG). - Springton, 27.7.1973, *J.A. Elix 204* (CBG). - **Tasmania:** Hunting Grounds, c. 4.5 km west of Dysart, 42°34'S, 147°10'E, 400 m, 7.3.1981, *G. Kantvilas & P. James 459/81* (HO). - Maria Island National Park, 1 km E of Darlington, at the Fossile Cliffs, 42°35'S, 148°04'E, 12.3.1981, *L. Tibell 11402* (UPS). - Royal George, Mine area, *G.C. Bratt 350* (HO). - **Victoria:** Cathedral Range, near Melbourne, Mt. Sugarloaf, c. 800 m, 12.9.1987, *R.B. Filson & H.T. Lumbsch 5655d* (hb. Lumbsch). - **Western Australia:** 2 km S of Eleker Rd turn-off on Frenchman's Bay Rd, near Princess Royal Harbour, 18.4.1980, *D.H.S. Richardson 108* (PERTH). - Toolbrunup Peak, Stirling Ranges, 19.4.1980, *D. Richardson 172* (PERTH). - **NEW ZEALAND** - Canterbury, Banks Peninsula, 1.1.1981, *L. Tibell 10170, 10171* (UPS). - Cass, on boulders of greywacke in *Discaria-Festuca* tussock country above the Biological Station, 43°03'S, 171°65'E, 8.1.1927, *G. Einar & G. Du Rietz 1454:12* (UPS). - SW slopes of Foggy Peak, Torlesse Range, 1040 m, 23.3.1980, *J.A. Elix 7763* (CBG). - Lees Valley road, 7 km N of Oxford, 460 m, *J.A. Elix 8303* (CBG). - Otago, Queenstown, S slopes of Queenstown Hill, 700 m, 4.3.1980, *J.A. Elix 7564* (CBG).

AFRICA - Angola: Huambo, Vila Flor, near Canjangue, c. 1700 m, 18.2.1960, *G. Degelius* (UPS). - Rio Coquema, W of Silva Porto, c. 1700 m, 17.2.1960, *G. Degelius* (UPS). - **Malawi:** Nyika National Park, 10°38'S, 33°53'E, 2300 m, 1991, *A. Aptroot* (hb. Aptroot).

AMERICA - Argentina: Prov. Catamarca, Nevados de Anconquija, valley of the Rio Pisavil, 3000 m, 20.11.1948, *I.M. Lamb 5508* (CANL, UPS). - Prov. Tucuman, Valle de Tafi, Parafunco-Infiernillo, 2800 m, 18.11.1947, *I.M. Lamb 5176* (CANL). - **Bolivia:** Prov. Larecaja, 2970-3000 m, 2/1879, *G. Mandon 1983* (S). - **Brazil:** Minas Gerais, São João d'el Rey, 30.8.1892, *G. A. Malme 247* (S). - Serra do Espinhaço, Serra do Caraça, near the cloister Caraça, 8.7.1978, *K. Kalb & G. Plöbst 27414* (hb. Kalb). - Rio Gande do Sul, Porto Alegre, 31.5.1893, *G.A. Malme 132, 582* (S). - **Mexico:** Baja Californica Norte, Punta Banda, Los Arbolitos, ca. 15 m alt., 6.9.1977, *L.Tibell 7783, 7792* (UPS), Michoacán, Rincón, Morelia, 2000 m, 3.3.1910, *B.G. Arsène 444g* (UPS). - **Peru:** Dept. Cuzco, Prov. Urubamba, valley of Rio Piri, 16-17 km road distance from Ollantaytambo, 13°7'S, 72°22'W, 3200-3300 m, 23.3.1981, *R. Santesson P85/17* (S). - **Uruguay:** Maldonado, Abra de Perdomo, 1.3.1949, *H.S. Osorio 1900* (CANL). - Montevideo, Carrasco, Cañada de las Canteras, 19.2.1951, *H.S. Osorio 2645* (S, UPS).

2. Lecanora ochroidea (Ach.) Nyl.

Lich. Envir. Paris: 59 (1896). - *Lichen ochroides* Ach., Lichenogr. Suec. Prod.: 72 (1798), nom. nov. pro *Lichen lutescens* Pers., Ust. Ann. Bot. **7:** 26 (1794), non Hoffm. - *Lecidea ochroidea* (Ach.), Meth. Lich.: 72 (1803). - *Lecanora subcarnea* var. *ochroidea* (Ach.) Ach., Lich. Univ.: 366 (1810). - *Lichen subcarneus* * *Lecanora ochroidea* (Ach.) Lam., Encycl. Meth. Bot. Suppl. **3**: 377 (1813). - *Lecanora rimosa* var. ("γ") *subcarnea* f. ("b") *ochroidea* (Ach.) Hepp, Flecht. Europ.: no. 904 (1867). - *Zeora subcarnea* var. *ochroidea* (Ach.) Arnold, Flora **53:** 214 (1870). - *Lecanora glaucoma* var. *subcarnea* subvar. *ochroidea* (Ach.) Boistel, Nouv. Fl. Lich., 2. part.: 143 (1903). - Type: Italy, Sardinia, Prov. Nuoro, Barbagia Seulo, M. Arbo, Valle del Rio S. Girolamo, from the Train Station S. Girolamo to Casa Forestale, 39°51'N, 9°24'E, 900-1100 m, 16.7.1987, *J. Poelt* (GZU-neotype, here selected).

(Fig. 1 C)

Thallus crustose, uniform, adnate, thick to thin, rimose- to verrucose-areolate, yellowish white to creamish, without pruina, soredia absent, prothallus lacking.

Apothecia sessile, 0.75-2.0 mm in diam., discs carneous to pinkish, light pinkish when wet, heavily whitish grey pruinose, plane to convex, margins prominent, persistent, smooth, flexuose, concolorous with thallus. Cortex absent, amphithecium with numerous small crystals, slowly dissolving in KOH, parathecium with small crystals, ca. 15 μm thick, epihymenium granular with small crystals, grey-brown, 10-15 μm tall. Hymenium hyaline, 50-70 μm tall, subhymenium hyaline, paraphyses sparsely branched, apically slightly thickened. Asci clavate, 8-spored. Ascospores hyaline, non-septate, ellipsoid to broadly ellipsoid, 10-13 x 5,5-8,5 μm.

Chemistry: Major substances: atranorin and norstictic acid; minor substances: chloroatranorin, connorstictic and ± salazinic acids.

Remarks: *Lecanora ochroidea* is characterized in the main by the presence of norstictic acid. In addition it has somewhat larger apothecia than *L. subcarnea* and the colour of the thallus differs slightly.

Variability: This species is chemically, morphologically and anatomically rather uniform. Only in the presence of accessory salazinic acid does the chemistry vary.

Nomenclature: The name *Lichen ochroides* was introduced by Acharius (1798) as a nomen novum for *Lichen lutescens* Pers., non Hoffm. He mentioned that he had not seen authentic material, but relied on the literature. The description by Persoon (1794: 26-27) was rather brief, but is consistent with the current concept of *Lecanora ochroidea*. No material of *Lichen lutescens* was found in the Persoon herbarium at Leiden and the type must be regarded as lost. Therefore a neotype has been chosen. This species was originally described from Germany ("..prope Ilfeld in subharcynia.."). Although material from Germany is available, the specimens are rather poor, and indeed no mature spores were seen in collections from Central Europe, so a well developed specimen from Sardinia has been selected as neotype. When Acharius compiled the Methodus (Acharius 1803) he received material of *Lichen flexuosus* Pers., which he placed into synonymy with *L. ochroidea*. Such material is present in H-ACH (No. 342). Claude Roux has studied this material in the Acharius herbarium in 1982 and selected one specimen of the eight pieces present under this number as lectotype of *Lecanora ochroidea* (Vitikainen, in litt.). This procedure cannot be followed here for the reasons mentioned above. The decision by Acharius to place *Lichen flexuosus* into synonymy with *L. ochroidea* was a purely taxonomic one and does not influence the nomenclature of that species. We reexamined the material purported to be the lectotype by Roux and agree that it represents *Lecanora subcarnea*. Therefore *Lichen flexuosus* has to be placed under synonymy with *Lecanora subcarnea* and not *L. ochroidea*.

Ecology and distribution: *Lecanora ochroidea* occurs on somewhat shaded, often overhanging, siliceous rocks in Southern and Central Europe and the Canary Islands.

Selected specimens examined: **GERMANY** - Sachsen, Elbsteingebirge, Hohnstein, Hockstein, 26.3.1916, *A. Schade 1804* (UPS). - **ITALY** - Sardinia, Prov. Sàssari, Passo La Variante, S Témpio Pausania, Lu Colbu, 5.5.1986, *H. Mayrhofer 6247* (GZU); Prov. Nuoro, Gennargentu, Mts. Arcu Correboi, Montarbu (left of the road) and M. Mandra de Caia (right of the road), 40°04'N, 9°21'E, 1250 m, 17.7.1987, *J. Poelt* (GZU).

AFRICA: Canary Isles, Tenerife: La Orotava, Los Organos near Aguamansa, 1150 - 1250 m, 15.7.1986, *O. Breuß 4328* (GZU); Puerto de la Cruz, SE of the Botanical Garden, 22.1.1973, *N.Lundqvist 8144* (UPS).

3. Lecanora rhodi Szatala

Denkschr. Akad. Wiss. Wien, math.-naturw. Kl. **105:** 38 (1943). - Type: Greece, Rhodos, M. Profeta, 700 m, 5.1935, *K.H. Rechinger* (M-isotype).

(Fig. 1 D)

Thallus crustose, uniform, adnate, relatively thick, rimose- to verrucose-areolate, yellowish white to creamish, without pruina, soredia absent, prothallus lacking.

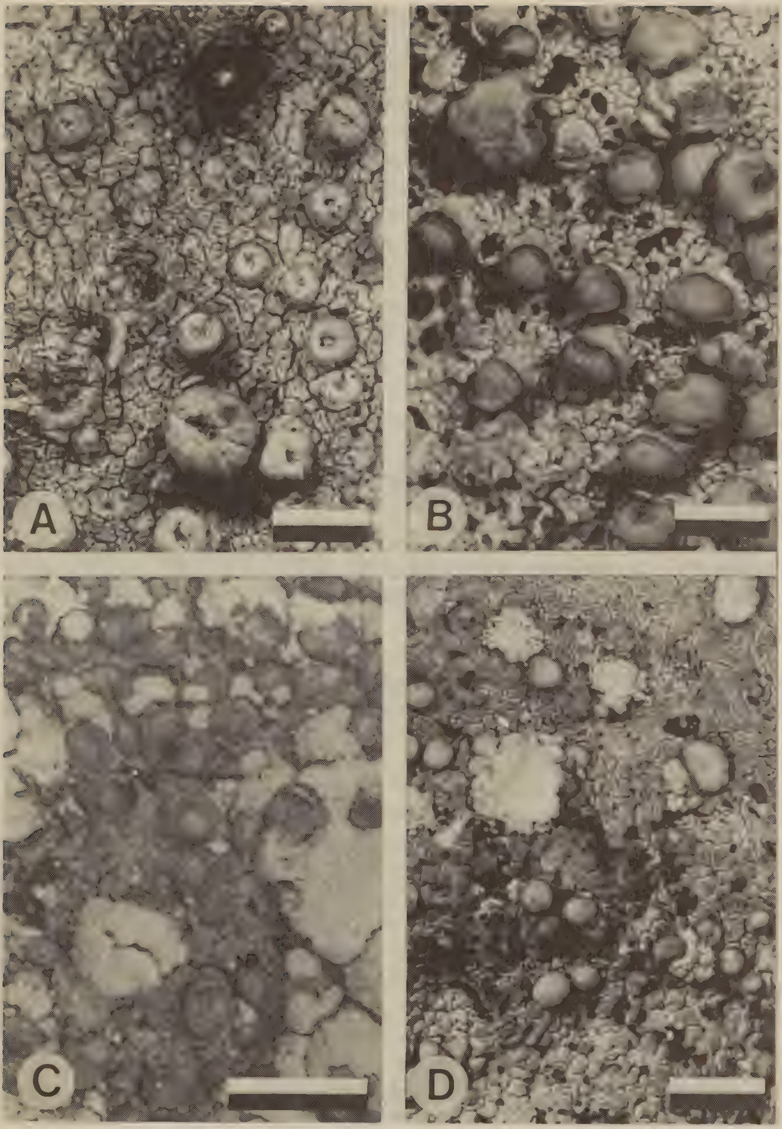


Fig. 3. A. *Lecanora-sanctae-helenae*, holotype (G). - B. *Lecanora subcarnea*, neotype (UPS); C. & D. *Lecanora subcarnea* var. *soralifera*, C. *Magnusson 19641* (UPS), D. holotype (UPS).

Apothecia sessile to constricted at base, 0.4-2.0 mm in diam., discs reddish-orange, heavily whitish grey pruinose, plane to strongly convex, margins prominent, becoming excluded, smooth, entire or flexuose, concolorous with thallus. Cortex absent, amphithecium with numerous small crystals, rapidly dissolving in KOH, parathecium with small crystals, ca. 20 μm thick, epihymenium granular with small crystals, grey-brown, 10-15 μm tall. Hymenium hyaline, 50-65 μm tall, subhymenium hyaline, paraphyses sparsely branched, apically slightly thickened. Asci clavate, 8-spored. Ascospores hyaline, non-septate, ellipsoid to broadly ellipsoid, 10-13.5 x 5-7 μm.

Chemistry: Major substances: atranorin, norstictic and 2'-*O*-methylperlatolic acids; minor substances: chloroatranorin, connorstictic acid and unidentified depsides.

Remarks: *Lecanora rhodi* is characterized by the reddish-orange apothecial discs, the basally constricted apothecia and the presence of 2'-*O*-methylperlatolic acid. The spores tend to be somewhat thinner than those of other species of the group.

Variability: Although only a limited number of specimens were available in this study the material examined was rather uniform.

Ecology and distribution: *Lecanora rhodi* occurs on siliceous rocks in Europe and has an Atlantic-Mediterranean distribution. It has previously been overlooked and is here reported as new for France and Italy.

Exsiccatae examined: Massal., Lich. Ital. 309 (S), Vezda, Lich. sel. 389 p.pt. (M).

Additional specimens examined: **FRANCE** - Fontainebleau, *W.Nylander* (M). - **ITALY** - Sardinia, Prov. Cagliari, Giara di Gesturi, above Gesturi, 550 m alt., 8°59'E, 39°44'N, 14.7.1987, *I.M. Brodo 25533* (CANL); Prov. Núoro: Catena del Marghine, N below Pita Palai, 850 - 920 m, 24.7.1985, *P.L. Nimis & J. Poelt* (GZU); Catena del Marghine, Nuraghe Ortachis, near Pita Palai, 950 m alt., 8°54'E, 40°22'N, 25.7.1987, *I.M. Brodo* (CANL). - Isle of Pisano, 3/1926, *Lunardi 17* (UPS). - Montarbo: N Ussassái, 950-1060 m, 4.5.1986, *H. Mayrhofer 6164, 6166* (GZU), Prov. Cagliari, Giara di Gésturi, above Barumini, 20.7.1985, *P.L. Nimis & J. Poelt* (GZU).

4. Lecanora sanctae-helenae Müll. Arg.
Hedwigia **32:** 124 (1893). - Type: St. Helena, 1892, *J.C. Melliss* (G-holotype).

(Fig. 3 A)

Thallus crustose, uniform, adnate, rather thick, rimose-areolate to verrucose-areolate, greyish white to creamish, soredia absent, prothallus lacking.

Apothecia adnate to sessile, 0.5-2 mm in diam., discs carneous to pinkish, heavily whitish grey pruinose, plane to convex, margins thick, prominent, persistent, smooth, entire, concolorous with thallus. Cortex inspersed with small crystals dissolving in KOH, indistinct, 25-35 μm thick, amphithecium with numerous small crystals, slowly dissolving in KOH, parathecium with small crystals, ca. 20 μm thick, epihymenium granular with small crystals, grey-brown, 10-15 μm tall. Hymenium hyaline, 60-80 μm tall, subhymenium pale yellowish, paraphyses sparsely branched, apically slightly thickened. Asci clavate, 8-spored. Ascospores hyaline, non-septate, broadly ellipsoid, 9-12 x 5-7 μm.

Chemistry: Major substances: atranorin, norstictic, placodiolic and protocetraric acids; minor substances: chloroatranorin, and salazinic acids.

Remarks: The relatively thick apothecial margins which are persistent and entire characterize *L. sanctae-helenae* morphologically while chemically the species can be distinguished by the presence of placodiolic acid. Anatomically this species is very close to *L. farinacea*, but the latter is readily distinguished by the absence of placodiolic acid.

Variability: As only two specimens were examined little can be said about the variability of this species at this stage.

Ecology and distribution: Both known collections of *L. sanctae-helenae* were collected on St. Helena, where the species occurs on siliceous rocks. No additional ecological data are given on the labels.

Additional specimen examined: **AFRICA**: St. Helena Island, Ocean shore, *E.F. Schäfer 4558* (PRE).

5. Lecanora subcarnea (Lilj.) Ach.

Lich. Univ.: 365 (1810). - *Lichen subcarneus* Lilj., Utk. Sv. Flora: 327 (1792). - *Lecidea subcarnea* (Lilj.) Ach., Meth. Lich.: 59 (1803). - *Patellaria angulosa* * *Lichen subcarneus* DC. in Lam. & DC., Fl. Franç., ed. 3, **2**: 363 (1805). - *Parmelia subcarnea* (Lilj.) Sprengel, Syst. Veg. **4** (1): 299 (1827). - *Parmelia sordida* var. *subcarnea* (Lilj.) Fr., Lich. Eur. Ref.: 179 (1831). - *Parmelia rimosa* var. *subcarnea* (Lilj.) Schaer., Lich. Helv. Spic. **8**: 386 (1839). - *Lecanora rimosa* var. *subcarnea* (Lilj.) Rabenh., Deutschl. Krypt. Fl. **2**: 31 (1845). - *Parmelia glaucoma* var. *subcarnea* (Lilj.) Fr., Summa Veg. Scand. **1**: 108 (1846). - *Zeora sordida* var. *subcarnea* (Lilj.) Flot., Jber. Schles. Ges. Vaterl. Kultur **27**: 123 (1849). - *Patellaria rupicola* var. *subcarnea* (Lilj.) Trev., Spighe e Paglie: 52 (1853). - *Lecanora glaucoma* f. *subcarnea* (Lilj.) Nyl., Act. Soc. Linn. Bordeaux **21**: 333 (1856). - *Lecanora sordida* var. *subcarnea* (Lilj.) Th. Fr., Nova Acta Reg. Soc. Sci. Ups., Ser. 3, **3**: 215 (1861). - *Zeora subcarnea* (Lilj.) Arnold, Flora **53**: 215 (1870). -

Type: Sweden, Östergötlands Skärgård, Stegeborg, 1818, *G. Wahlenberg* (UPS-neotype, here selected).

Syn: *Lecanora trevisanii* Massal., Sched. Crit. **9:** 165 (1856), nom. nov. pro *Lecanora pallescens* Massal. Ric. Auton. Lich.: 8 (1852), non Fr. - Type: Massal. Lich. Ital. 309 (UPS-lectotype, here selected).

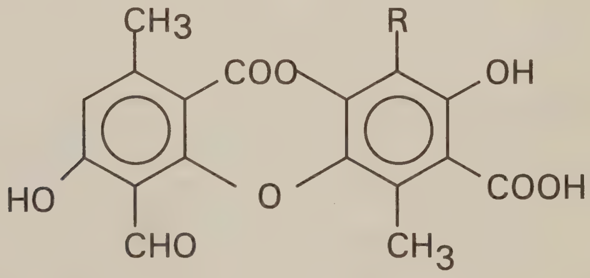
Lichen flexuosus Pers. ex Ach., Meth. Lich.: 73 (1803). - Type: "Germania" (H-ACH 342-holotype).

(Fig. 3 B)

Thallus crustose, uniform, adnate, thick to thin, sometimes farinaceous, rimose-areolate or continuous to verrucose-areolate, greyish white to yellowish white, sometimes yellowish green, soredia absent, prothallus whitish.

Apothecia sessile, 0.5-1.5 mm in diam., discs carneous to pinkish, heavily whitish grey pruinose, convex, margins prominent, becoming excluded, smooth, entire or flexuose, concolorous with thallus. Cortex absent, amphithecium with numerous small crystals, rapidly dissolving in KOH, parathecium with small crystals, ca. 20 μm thick, epihymenium granular with small crystals, grey-brown to yellowish-brown, 10-15 μm tall. Hymenium hyaline, 50-70 μm tall, subhymenium hyaline, paraphyses sparsely branched, apically slightly thickened. Asci clavate, 8-spored. Ascospores hyaline, non-septate, broadly ellipsoid, 10-14 x 6-9 μm.

Fig. 4. Structural formulae of protocetraric and virensic acids.



Protocetraric acid: $R=CH_2OH$
Virensic acid: $R=CH_3$

Chemistry: Chemotype I: Major substances: atranorin and protocetraric acid; minor substances: chloroatranorin and conprotocetraric acids. - Chemotype II:

Major substances: atranorin and virensic acid; minor substance: chloroatranorin.

Remarks: Chemically *Lecanora subcarnea* is characterized by the presence of protocetraric or virensic acids, but the morphological distinctions are not so clear cut. The apothecial margins become excluded, a feature which distinguishes this species from *L. farincea*. *L. subcarnea* can be distinguished from the other two species of the group in Europe by the colour of the thallus and the chemistry.

Variability: Morphologically *L. subcarnea* is rather uniform. Two chemical races occur within this species. The common chemotype contains protocetraric acid, while chemotype II with virensic acid is much rarer. At first we considered both chemotypes might merit taxonomic recognition. However, chemotype II occurs sporadically throughout the range of chemotype I and the two depsidones are very closely related biosynthetically, differing only in the presence (or absence) of a hydroxy-group in the 9-position of the B-ring (Fig. 4). This suggests that chemotype II is only a simple mutant of *L. subcarnea* which lacks the ability to oxidize the methyl-group at position 9 and that chemotype II itself is polyphyletic.

Nomenclature: The name *Lichen subcarneus* was first mentioned in Westring (1791) who recorded Swartz as the author of this name. However, this report cannot be interpreted as a valid description of the species, since it was not accompanied by a diagnosis (Art. 32.1.) and was certainly not meant as a taxonomic description, as the paper deals with the use of lichens for dyeing. The first valid publication of the name *Lichen subcarneus* was made by Liljeblad (1792), who did not refer to Westring or Swartz and therefore has to be considered as the only author of the name. As no material which could be used as lectotype was found in UPS or in H-ACH (Vitikainen, in litt.), a neotype has been chosen. The neotype comes from the same region as the original material (Östergötland) and represents a typical and well developed specimen of the species.

Ecology and distribution: *Lecanora subcarnea* occurs on shaded, often overhanging siliceous rocks in Europe and western North America. In Europe it is a rather common lichen.

Chemical race I:

Selected exsiccatae examined: Anzi Lich. rar. Etr. 19 (S); Erbar. Crittog. Ital. 674 (M); Follmann, Lich. sel. 213 (GZU, M, UPS); Harmand, Lich. Loth. 592 (M); Havaas, Lich. Norv. Occid. 19 (M); Hepp, Flecht. Europ. 710, 904, 905 (M, S); Körb., Lich. sel. germ. 217 (M); Massal., Lich. Ital. 309 (UPS); Rabenh., Lich.

europ. 373 (S), 949 (M, S); Räs., Lich. Fenn. 407 (S); Tavares, Lich. Lusit. sel. 69 (M), Zw., Lich. 75 (S).

Selected specimens examined: **AUSTRIA** - Engelhartszell, 23.4.1877, *F. Grims* (GZU). - **FRANCE** - Corsica, Dept. Haute-Corse: Golo valley, ca. 5 km E of Ponte Leccia, ca. 180 m, 6.11.1993, *H. Komposch* (GZU); Asco valley, S of Moltifao, NE of Gorges de l'Asco, ca. 290 m, 2.11.1993, *H. Mayrhofer & E. Unger* (GZU). - Bretagne, Côtes du Nord, valley of Poulancre near Gilles, 18.7.1954, *O.L. Lange & C. Tavares* (M). - **GERMANY** - Bavaria: Fichtelgebirge, 1860, *W. Gumbel 64* (M). - Baden Württemberg, Heidelberg, July/August 1878, *Zwackhausen 75, 210* (M). Hessen, Kreis Limburg/Weilburg, way from Villmar to Arfurt, ca. 1 km S of Krammsmühle, ca. 120 m alt, 5.4.1989, *H.T. Lumbsch & E. Mietzsch 6708 e, f, g* (hb. Lumbsch). - Rheinland-Pfalz, S Eifel, Lkr. Bernkastel-Wittlich, Elfengrotte near Bad Bertrich, 26.5.1990, *H.T. Lumbsch 7688* (hb. Lumbsch). - **ITALY** - Calabria, Aspromonte, Prov. Reggio di Calabria, Pietra Impiccata, ca. 1700 - 1750 m, 12.7.1988, *J. Poelt* (GZU). - Sardinia, Prov. Cagliari, Giara di Gésturi, above Barumini, 20.7.1985, *P.L. Nimis & J. Poelt* (GZU); Prov. Núoro, Gennargentu, Arcu Correboi, Mte Armario, ca. 1235 - 1300, 5.5.1986, *J. Poelt* (GZU). - **NORWAY** - Hordaland, Isle Stord, Sandvikvag, Gem. Fitjar, *A. Buschardt, P.M. Jörgensen & J. Poelt* (GZU). - **PORTUGAL** - Beira-Alta, Serra da Estrêla, Desterro, 10.9.1951, *C. Tavares* (UPS). Castelo de Lankow, Sept. 1919, *G.Sampaio 2156* (UPS). - **SWEDEN** - Bohuslän, Between Dale and Spaktorpet (Dale vatten), 14.7.1966, *R. Santesson 18668* (M); Öckerö par., Rörö, NW part of the island, Munkhuvudet, 30.7.1977, *I. Kärnefelt 2725* (GZU) - Marstrand, NW of Göteborg, 19.8.1970, *H. Hertel & G. Degelius 11591* (M). - Tuve, Böneröd, 18.5.1937, *A.H. Magnusson 15593* (M). - Västergötland, Stora Amundön, near Göteborg, 4.9.1966, *J. Poelt 4134* (GZU). - Östergötland, Norrköping, Sjötullen, 1.7.1823, *G.Wahlenberg* (UPS). - **USA** - California, Los Angeles Co., Santa Catalina Island, between Cottonwood Canyon and Mills Landing, 0-300 ft., 5.4.1966, *W.A. Weber & R. Santesson* (CANL).

Chemical race II:

Exsiccata examined: Vezda, Lich. sel. 389 p.pt. (M).

Specimens examined: **AUSTRIA** - Haibach/Donau, near Hinteraigen, 19.3.1977, *Grims* (GZU). - **FRANCE** - Near Apt (Vaucluse), Fourjon (400 m), Gignac, 8/1957, *G. Clauzade & J. Poelt 228* (M). Haute-Loire, Le Chier, St. Didier d'Allier, 16.8.1952, *G.Clauzade 236* (UPS). - **GERMANY** - Taunus, near Homburg (GZU). - **SWEDEN** - Bohuslän, par. Öckerö, Björkö, 31.7.1916, *A.H. Magnusson* (UPS). - **SWITZERLAND** - *Salève* (M). - **TURKEY** - Anatolia, Prov. Izmir, Yamanlar Dagh, N slopes on the road to Karagöl, 38°32'N, 27°11'E, 750 m alt., *H.T. Lumbsch 3641* (hb. Lumbsch).

6. Lecanora subcarnea var. soralifera H. Magn.

Bot. Not.: 433 (1932). - Type: Sweden, Bohuslän, par. Ödsmål, Röd, 8.7.1930, *A.H. Magnusson 12364* (UPS-holotype).

(Fig. 3 C & D)

This variety can be distinguished from *Lecanora subcarnea* s. str. by the presence of soredia. The anatomy of the apothecia and the chemistry of the sorediate morph of *L. subcarnea* are identical with the typical variety. The taxonomic recognition of sorediate taxa within the genus *Lecanora* differs. While a sorediate morph of *L. epibryon* was not recognized at any taxonomic level by Brodo (1984), more recently other sorediate taxa in the *L. subfusca* group were treated as species or subspecies by Brodo et al. (1994). Alternatively the varietal rank was chosen by Leuckert & Poelt (1989) for sorediate taxa in the *L. rupicola* group. As we have not studied the European material in detail we prefer to maintain the sorediate morph of *L. subcarnea* at the variety level, simply because it was originally described as such by Magnusson. However, the sporadic occurrence of the sorediate morph throughout the range of distribution of *L. subcarnea* s.str. suggests, that var. *soralifera* is not a monophyletic entity.

Exsiccatae examined: Magn, Lich. sel. scand. 174 (GZU, UPS).

Selected specimens examined: **GERMANY** - Baden-Württemberg, Schwarzwald: Cryptogamma-Blockhalde S of Oberried, 25.1.1975, *F. Schuhwerk 971* (M); steep slope at the Utzenfluh near Utzenfeld, Kreis Lörrach, 600-650 m, 16.5.1967, *J. Poelt 4504* (GZU). - **SWEDEN** - Bohuslän, Ljangskile, 4.8.1941, *A.H. Magnusson 17855* (UPS); Norum, St. Askerön, 17.7.1948, *A.H. Magnusson 21135* (UPS); par. Ödsmål, Videsgärde, 31.7.1931, *A.H. Magnusson* (GZU); Koster-Archipel, Isle Nord-Koster, WSW of Strömstad, 58°54'N, 11°00'E, 13.6.1990, *J. Poelt* (GZU); Röd, par Ödsmål, 8.7.1930, *A.H. Magnusson 12364* (UPS). - Västergötland, Stora Amundön, near Göteborg, 4.9.1966, *J. Poelt 4139* (GZU); Partille, Bokedalen, 31.7.1945, *A.H. Magnusson 19641* (UPS); Kinnekulle, 8.6.1945, *G. Degelius* (UPS). - Halland, Fjasas, Brasselund, 2.6.1936, *A.H. Magnusson* (UPS).

Excluded species

Lecanora unicolor Sommerf.

Kgl. Norsk. Vid. Skr. **2**, 2. H.: 59 (1827). - Type: no data given, only "leg. Somft." (O-holotype).

This species was treated as a synonym of *Lecanora subcarnea* by Zahlbruckner (1928). A re-examination of the type material, however, showed that the type belongs to *Lecanora swartzii* ssp. *nylanderi* (Räs.) Leuckert & Poelt.

We wish to thank the curators of the herbaria cited and the private collectors for sending us specimens in their care for examination. Dr. Roland Moberg and Prof. Dr. Rolf Santesson (Uppsala) and Dr. Orvo Vitikainen (Helsinki) kindly helped us with nomenclatural problems. Mr. H. Ullrich (Goslar) is thanked for his attempts to find material of *L. ochroidea* in the Harz Mountains at the original locality. We thank Prof. Dr. J.A. Elix (Canberra) for his comments on the manuscript and help with the chemistry of critical specimens. This study was supported by the Deutsche Forschungsgemeinschaft (Fe 89/6-1).

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CULTURAL CHARACTERS, COMPATIBILITY TESTS AND TAXONOMIC REMARKS OF SELECTED POLYPORES OF THE PATAGONIAN ANDES FORESTS OF ARGENTINA

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SUMMARY

Cultural features of seven polypores (Aphyllophorales, Basidiomycetes) that decay standing and/or fallen trees of several *Nothofagus* species in southern Argentina are described. The species are *Fistulina hepatica* Schaeff.: Fr., *Grifola sordulenta* (Mont.) Sing., *Macrohyporia dictyopora* (Cke.) Johans. & Ryv., *Phellinus andinopatagonicus* (Wright & Desch.) Ryv., *Phellinus livescens* (Speg.) Rajchenb., *Polyporus gayanus* Lév., and *Postia pelliculosa* (Berk.) Rajchenb. Cultures of red, yellow and flesh-colored forms of *F. hepatica* that grow on different *Nothofagus* species were similar, supporting the treatment of each form as a single taxon. *Macrohyporia dictyopora* causes a brown rot of wood with cultural characters similar to those of *M. cocos* (Schw.) Johans. & Ryv., a fact that does not support the segregation of *M. cocos* in a different genus, i.e. *Wolfiporia* Ryv. & Gilb. *P. andinopatagonicus* is dimorphic in culture conditions, presenting either a bleaching or a staining form. The secondary mycelia of *M. dictyopora* and of *P. andinopatagonicus* are multinucleate, while that of *P. livescens* is di-trikaryotic. *Polyporus gayanus* and *P. pelliculosa* have a bifactorial mating system and have a normal nuclear pattern of the mycelia. Monokaryotic x monokaryotic and dikaryotic x monokaryotic compatibility tests performed between specimens of *P. pelliculosa* from Argentina, Australia and New Zealand showed a high degree of compatibility. Thus supporting the synonymy of *Spongipellis chubutensis* Wright & Desch., a later name used in Argentina, under *P. pelliculosa.* *Antrodia stratosa* (Wright & Desch.) Rajchenb. has a unifactorial mating system and heterocytic nuclear behavior. The incorporation of *A. stratosa* in *Amyloporiella* David & Tortic is discussed.

INTRODUCTION

The polypore flora of the Patagonian Andes in Argentina has been regularly studied since the first survey made by Wright & Deschamps (1972). Several works by Hjortstam & Ryvarden (1985) and Rajchenberg (1983, 1987, 1989, 1993, 1994a, 1994b, 1994c and 1995) have revised its composition and provided data on the biology of several species.

During the study of wood-rots found in standing *Nothofagus pumilio* (Poepp. & Endl.) Krasser (Cwielong & Rajchenberg, 1995), the main native forest resource in Patagonia, we isolated and studied the cultures of several polypores, of which we knew little or nothing of their cultural features, mating system and/or nuclear behavior of their mycelia. We herein present the results of this study. We also include information regarding two species that grow on other *Nothofagus* species.

MATERIALS AND METHODS

Cultures were isolated from fresh tissue of fruitbodies or from wood-rots. They were studied and described according to Nobles (1965). The species codes describing 6 week-old cultures follow the system of Nobles (1965) with the modifications summarized in Nakasone (1990). The cultures were grown on malt extract agar in the dark at 25° C. The rate of growth was expressed as the radial growth of the mat at the end of the study or as the number of weeks required by the cultures to cover the agar in a 9 cm. Petri dish from an inoculum at the side. Oxidase reactions and mat diameters were recorded at 1 week after inoculation in the dark at 25 °C. Gallic acid (GAA) and tannic acid (TAA) agar media were made according to Nobles (1965) while tyrosine agar medium (TyA) was made according to Nakasone (1990).

The nuclear behavior (Boidin, 1971) was examined according to the dyeing procedure described by Boidin (1958). Mating tests and monokaryotic x monokaryotic and dikaryotic x monokaryotic compatibility tests were performed according to Hallenberg (1984). After the mycelia had been in contact for 6-8 weeks they were examined to determine the presence of clamps connections. When there were no clamp connections the mycelia were left in contact for longer periods and were examined regularly until the agar medium was dry. Mating types were assigned arbitrarily.

Cultures are kept at the authors' laboratory as 'CIEFAP n°'; some duplicates were also incorporated in BAFC. MR refers to specimens (fruitbodies) collected and/or numbered by the senior author and from which cultures were obtained. Specimens that were not numbered are indicated as s.n. (sine numero = without number).

RESULTS

Antrodia stratosa (Wright & Desch.) Rajchenb., Bol. Soc. Argent. Bot. 22: 42, 1983.

Fruitbody description in Wright & Deschamps (1972) and Rajchenberg (1983). **Cultural characters** in Rajchenberg (1983).

Sexuality: bipolar. Monosporic cultures of *A. stratosa* were obtained from the sporulation of BAFC culture 43 (Argentina, Chubut, Los Alerces National Park, path to Lake Menéndez, ca. P° Chucao, on fallen trunk of *N. dombeyi*, MR, 17.Jan.82, BAFC specimen 27786). Twenty monosporic cultures were distributed as:
A_1: 2, 4, 5, 9, 10, 12, 13, 14, 15, 17, 18, 20.
A_2: 1, 3, 6, 7, 8, 11, 16, 19.

Nuclear behavior: heterocytic. Spores are uninucleate. Monosporic cultures are multinucleate, with more than 700 nuclei in the first hyphal segment. It was impossible to find the first septum of the monosporic mycelium. Polysporic dikaryotic mycelium was clamped in aerobic as well as in anaerobic conditions.

Remarks: David & Tortic (1984) segregated from *Antrodia* the species with heterocytic nuclear behavior into a genus of their own, i.e. *Amyloporiella* David & Tortic. It included species with resupinate habit, chalky consistency, bitter taste, and some species with hyphae with walls that dissolve in KOH solution and that have an amyloid reaction in mass. Some species are perennial. Some of the species were tetrapolar, (David & Tortic, 1984), contrasting with the bipolarity and homothallism known from most other species of *Antrodia*. The validity of this genus, based on those characters, seems uncertain, when we consider that:
a) *Antrodia oleracea* (Davids. & Lomb.) Ryv. and *A. alpina* (Litsch.) Gilb. & Ryv., which were also included in *Amyloporiella*, have a normal nuclear behavior (David & Tortic, 1984).
b) *A. oleracea* has a unifactorial compatibility system, as shown by Lombard (1990).
c) *A. stratosa*, though presenting a heterocytic nuclear behavior, has a coriaceous or a corky consistency, its hyphae do not swell in 5% KOH and are not amyloid, and its mating system is unifactorial.

According to these examples it seems to us that there exists variability regarding the characters used to create the new genus. Therefore we do not consider appropriate to support it (cfr. Renvall & Niemela, 1992). For a nomenclatural treatment of *Amyloporiella* see Ryvarden (1991). The morphological uniformity in fruitbodies of *Antrodia* species is supported by their cultural features, all the species presenting clamped, generative hyphae with irregular thickened walls. On this respect it is interesting to note that species in *Fibroporia* Parm. lack this type of hyphae in culture conditions as well as in the fruitbodies. Also, the fruitbodies of this genus differ from those of *Antrodia* by the few skeletal hyphae present either in the context or in the dissepiments. This, together with the tetrapolarity presented by all the species so far included in *Fibroporia*, supports its segregation from *Antrodia*.

Fistulina hepatica Schaeff.: Fr., Syst. Mycol. 1: 396, 1821.

Fruitbody descriptions in Wright (1961) and Wright & Deschamps (1975).
Cultures studied: RED FORM: CIEFAP 147, Argentina, Chubut, Futaleufú, Los Cipreses, La 106, on stump of *Nothofagus antarctica*, MR 10698 and C. Barroetaveña, 30.Apr.92. CIEFAP 123, Ibid., Los Alerces National Park, Lake Futalaufquen, margin N, cascade of Irigoyen stream, on *N. dombeyi*, MR 10585, 27.Feb.92. CIEFAP 110, Argentina, Neuquén, Lanín National Park, Lake Lolog, on standing *N. dombeyi*, MR 10693 and P. Cwielong, 13.Apr.92. FLESH-COLORED FORM: CIEFAP 33, Chubut, Futaleufú, Lake Rosario, on standing *N. pumilio*, MR 10404 and P. Cwielong, 26.Mar.91. CIEFAP 51, Ibid., Río Senguer, El Triana, on standing *N. pumilio*, MR 10449 and P. Cwielong, 15.Apr.91. CIEFAP 122, Ibid., MR 10636, 2.Apr.92. Eight cultures isolated from wood-rots of standing *N. pumilio* from Chubut, Río Senguer, Lake La Plata, Mar.94 and El Triana, Mar.92 (not incorporated to the culture collection). YELLOW-FORM: CIEFAP 115 and 143, Neuquén, Lanín National Park, Lake Lolog, margin N, on standing *N. alpina*, MR 10691 and 10692, respectively, 13.Apr.94.

Macroscopic characters: Mats subfelty or slightly felty throughout the dish, always scarce (Fig. 7A); margin regular or irregular and arachnoid; growing very slowly, 5-7 cm by 6 wk. Reverse unchanged. Odor absent or slightly fruity.
Oxidase reactions: GAA: -, tr-30 mm; TAA: -, tr-35 mm; TyA: -, tr.
Microscopic characters: Mycelial mat primarily composed of clamped generative hyphae, 4-5 µm diam., with hyaline, thin to slightly thickened walls (Fig. 1A), many hyphae devoid of cytoplasm, eventually forming ampuliform clamps (Fig. 1C). Gloeopleurous hyphae rarely present, 4-6 µm diam. Chlamydospores claviform, cylindric, ellipsoid or rectangular, 7-40 x 4-6 µm, with thickened walls and filled with small guttulae (Fig. 1B); rarely globose or subglobose, up to 15 µm diam., with much thickened walls (Fig. 1D).

Species code: 1.3c.7.27.34.36.40.47.50.54.

Remarks: *Fistulina hepatica* produces fruitbodies with different context colors in the *Nothofagus* forests of Argentina. They are deep chestnut-red when growing on *N. antarctica* and *N. dombeyi*, flesh-colored when growing on *N. pumilio* and yellow when growing on *N. alpina*. Spegazzini (1887, 1921) described as new species on *N. antarctica*, *Fistulina antarctica* from Staten

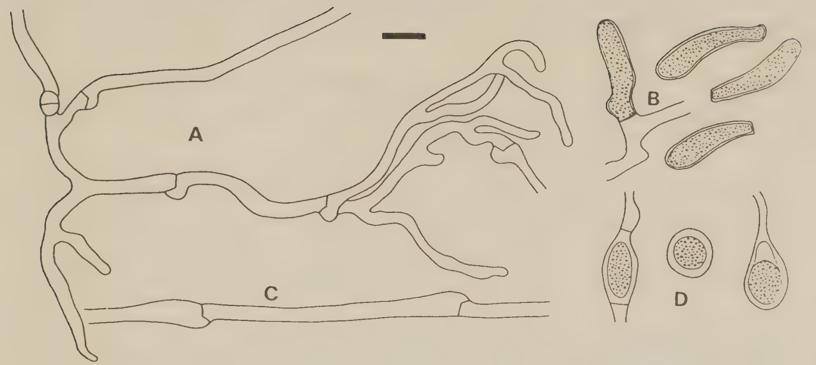


Fig. 1, *Fistulina hepatica*: Microscopic cultural features. A, generative hypha; B, cylindric to clavate chlamydospores; C, hypha with ampulate clamps; D, globose and subglobose chlamydospores. Bar = 10 µm

Island in Tierra del Fuego, and *F. endoxhanta* from Punta Arenas in Chile. Wright (1961), Wright & Deschamps (1972) and Rajchenberg & Wright (1987) treated Spegazzini's new species as varieties of *F. hepatica,* but Singer (1969) emphasized they were different taxa, though he did not present supporting data. In our four years collecting in the *Nothofagus* forests (though north from the Magellanic area) we found only *F. hepatica* growing on *N. antarctica*. We never found Spegazzini's species in our trips. The fruitbodies of *F. hepatica* found on *N. antarctica* were similar in shape, color and microscopic features to those growing on *N. dombeyi*, and both are similar to fruitbodies found in the northern hemisphere. The materials collected for this study grew on different substrates and in spite of differences in context color, their microscopic features were similar. Basidiospores did not germinate on standard medium (MEA) under lab conditions. As a result, compatibility tests could not be performed and the cultural features did not show differences between the forms.

Cultures of *Fistulina hepatica* are readily identified through the slow growth of the mat and the production of characteristic elongated chlamydospores. The species is associated with a brown rot in the substrate. In *N. pumilio, F. hepatica* never produces a well developed rot but instead develops a general reddish coloration of the heartwood. This coloration dissappears upon drying the timber.

Grifola sordulenta (Mont.) Singer, The Agaricales in the modern taxonomy 2nd Ed., p.300, 1962.

Fruitbody descriptions in Singer (1969) and Wright & Deschamps (1972).
Culture studied: CIEFAP 154, Argentina, Chubut, Los Alerces National Park, Lake Menéndez, Alerzal, on standing *N. dombeyi*, MR 10737, 15.III.93.

Macroscopic characters:Mat felty, but with different intensities along the dish, forming cottony, woolly or densely felty, radial areas (Fig. 7B), around the inoculum tuberculate; margins regular or irregular, felty or subfelty; growing very slowly, 5.5-7.5 cm by 6 wk. Reverse bleached. Odor similar to chestnut paste.
Oxidase reactions: GAA: -, tr.; TAA: (+), 0; TyA: +, 0.
Microscopic characters: Marginal hyphae clamped, thin-walled and rarely branched, 2.5-3.5 µm diam (Fig. 2A). Mat with similar hyphae but 1.5-3.5 µm diam. and frequently branched, often devoid of cytoplasm; some forming hyphal strands (Fig. 2B). Cottony and woolly areas formed by narrow generative hyphae with lateral, short branches, 1.0-1.5 µm diam. (Fig. 2C), first with cytoplasm but later empty and forming a net. Branched fiber hyphae also formed in old cultures, 1.0-2.5 µm diam. (Fig. 2D)

Species code: (1).2.3.8.32.36.40.47.53.54.

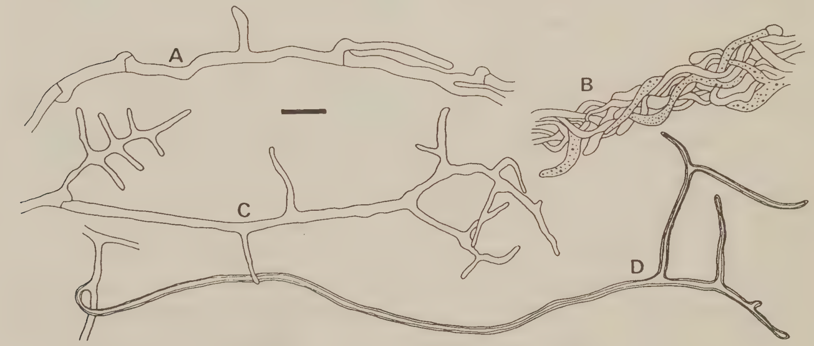


Fig. 2, *Grifola sordulenta*: Microscopic cultural features. A, generative hypha of the advancing mycelium; B, hyphal strand; C, generative hypha with short lateral branches; D, fiber hypha. Bar = 10 µm

Remarks: *Grifola frondosa* (Dicks.:Fr.) S.F. Gray, which grows on broad leaved trees in the northern hemisphere, is similar *G. sordulenta*. However, *G frondosa* differs in culture by a faster growth rate (the mat covers the dish after the 3rd week), by the formation of chlamydospores and by readily sporulating in culture (Nobles, 1965).

Macrohyporia dictyopora (Cke.) Johans. & Ryv., Trans. Br. Mycol. Soc. 72: 192, 1979.

Fruitbody descriptions in Ryvarden & Johansen (1980) and Buchanan & Hood (1992).
Cultures studied: CIEFAP 183, Argentina, Chubut, Río Senguer, Lake La Plata, isolated from a brown wood-rot in standing *N. pumilio*, III.93. CIEFAP 108, Neuquén, Lanín National Park, Lake Hermoso, margin N, on standing *N. dombeyi*, MR 10680, 11.Apr.92.

Macroscopic characters: Mat texture homogeneous, felty, with abundant, woolly-cottony mycelium against the dish wall (Fig. 7C), pellicular, easily detached with a nail; margin irregular; growing very rapidly, dish covered by the 2nd week. Reverse unchanged. Odor none.
Oxidase reactions: GAA: -, 70 mm; TAA: -, 65-80 mm; TyA: -to ++, 0-20 mm.
Microscopic characters: Marginal hyphae simple-septate, thin-walled, 3-8 µm diam., branched (Fig. 3A), may form intercalary or terminal, globose swellings, up to 20 µm diam. (Fig. 3B), that finally mature into chlamydospores.

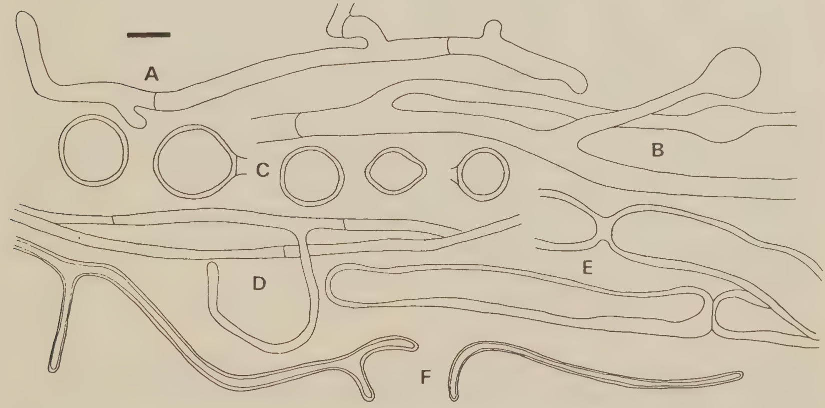


Fig. 3, *Macrohyporia dictyopora*: Microscopic cultural features. A, generative hypha of the advancing mycelium; B, terminal and intercalary swellings in marginal hyphae; C, chlamydospores; D, narrow generative hyphae; E, wide generative hyphae with uneven thickened walls; F, fiber hyphae. Bar = 10 µm

Chlamydospores globose or subglobose, 16-25 µm diam., with hyaline walls up to 2 µm thick (Fig. 3C). Felty mat formed by simple-septate, narrow and branched generative hyphae, 2-3 µm diam. or 4-12 µm diam. (Fig. 3D). Wider hyphae have unevenly thickened walls and the cells separate at the septa, forming hyphal segments with thickened walls (Fig. 3E). Towards the end of the study a few, branched, 1.5-2.5 µm diam. fiber hyphae are formed (Fig. 3F).

Cytology: The hyphal segments of the polysporic cultures are multinucleate. Some assays of numbers of nuclei made starting from the terminal cell are as follows:
CIEFAP 108: 18-7-9-22-; 21-11-8-13-; 17-9-14-
CIEFAP 183: 20-7-8-7-; 18-8-9-; 22-8-12-

Species code: 1.6.8.(26).34.36.38.42.54.

Remarks: We verify that *M. dictyopora* produces and is associated with a brown rot in the substrate, as already indicated by Buchanan & Hood (1992). Ryvarden (1991) pointed out that the associated wood-rot of this species is white, but this is certainly an error. The cultural features of *M. dictyopora* are similar to those of *Poria cocos* Schw., a species that was also included in the genus *Macrohyporia* (Johansen & Ryvarden, 1979; Ryvarden & Johansen, 1980). *Poria cocos* is characterized in culture by: simple-septate generative hyphae, fiber hyphae, wide, thick-walled generative hyphae and negative results of the oxidase reactions (Nobles, 1958; Stalpers, 1978; Ginns & Lowe, 1983, sub *Macrohyporia extensa* (Pk.) Ginns & Lowe). Ryvarden & Gilbertson (1984) created the genus *Wolfiporia* to accomodate *P. cocos* and segregated it from *Macrohyporia* based upon basidiospore shape: they are thin-walled and cylindric in *P. cocos* and slightly thick-walled and globose-subglobose in *M. dictyopora*. Both species, however are similar in other features of their fruitbodies: both are resupinate, have a dimitic hyphal system with wide simple-septate generative hyphae and branched skeletal hyphae (in *P. cocos*), or ligative hyphae (in *M. dictyopora*). Given these similarities, plus their similar cultural features, and the association with a brown rot, it seems that the new genus for *P. cocos*, based only on the basidiospore features is unnecessary.

Phellinus andinopatagonicus (Wright & Desch.) Ryv. in Hjorts. & Ryv., Mycotaxon 22: 164, 1985.

Fruitbody descriptions in Wright & Deschamps (1972 and 1975).
Cultures studied: CIEFAP 2, Argentina, Chubut, Futaleufú, Huemules ravine, on standing *N. pumilio*, MR s.n. and P. Cwielong, 22.Jan.91. CIEFAP 3, Ibid., but isolated from the

associated wood-rot. CIEFAP 23, Ibid., Kaquel Ranges, on fallen trunk of *N. pumilio*, MR s.n. and P. Cwielong, 31.Jan.91, isolated from wood-rot. CIEFAP 43, Ibid., Lake Baggilt, on the base of a standing *N. pumilio*, P. Cwielong and N. Rodríguez (MR 10431), 2.May.91. CIEFAP 42, Ibid., but isolated from the associated wood-rot. CIEFAP 181, Río Senguer, El Triana, on standing *N. pumilio*, isolated from wood-rot, Apr.91. CIEFAP 29, Tehuelches, Lake Vintter, margin S, on fallen trunk of *N. pumilio*, MR s.n., 12.Feb.91. CIEFAP 30, Ibid., but isolated from the associated wood-rot. CIEFAP 54, Los Alerces National Park, Mt. Dedal, on the base of a standing *N. pumilio*, MR 10462 et al., 22.Apr.91. Besides, 44 cultures isolated from wood-rots found on standing *N. pumilio* in Chubut, Río Senguer, El Triana, Apr.91 and Lake La Plata, Mar.93.

Macroscopic characters: Mats dimorphic. Different strains or different cultures of the same strain may present one of the following two aspects:

A) Bleaching type: Mats white, homogeneously felty to subfelty (Fig. 7D), sometimes forming denser, cottony spots in the center; against the dish wall, a woolly-felty mycelium formes that becomes yellowish or chestnut brown towards the end of the study; margins regular and felty; growing slowly, the dish covered in the 5th week. Reverse bleached. Odor absent.

B) Staining type: Mats fan-shaped, subfelty or arachnoid, hyaline, lax (Fig. 7E); submerged mycelium dense and abundant; margins irregular and subfelty; growing very slowly, not more than 7 cm by 6 wk. Reverse staining homogeneously or in furrows of dark chestnut brown or caramel. Odor absent.

Oxidase reactions: GAA: +++ to ++++, 0-tr.; TAA: ++ to ++++, 0-tr.; TyA: -, tr.

Microscopic characters: Marginal hyphae simple-septate, much branched, 2-5-(7) µm diam. Back from the margin the hyphae become wider in their principal axis, 5-6-(7) µm diam., with narrower lateral branches, 2-4 µm diam., and form H-shaped anastomoses with contiguous hyphae (Fig. 4A). Short and swollen segments are also formed (Fig. 4B). Cottony spots consist of much septated generative hyphae and terminal or intercalary hyphal segments with thickened, yellowish or chestnut brown walls (Fig. 4C), that are devoid of cytoplasm and do not become typical fiber hyphae. Hyphae with slightly thickened, yellowish walls that develop yellowish or caramel-colored cytoplasmatic contents are also formed (Fig. 4D). In cultures of the bleaching type, hyphae with much branched, digitiform, short, lateral branches are formed, which develop yellowish or light to dark chesnut brown, slightly thickened walls (Fig. 4E). These structures may be inconspicuous or may develop extensively to form a plectenchyma.

Cytology: The hyphal segments of the polysporic cultures are multinucleate. Some assays of numbers of nuclei made starting from the terminal cell are as follows:

CIEFAP 42: 19-13-11-13-; 28-17-5-6-8-5-7-; 49-4-6-
CIEFAP 29: 41-10-5-10-; 54-12-8-7-8-
CIEFAP 2: 57-33-42-12-20-33-; 62-19-9-7-8-

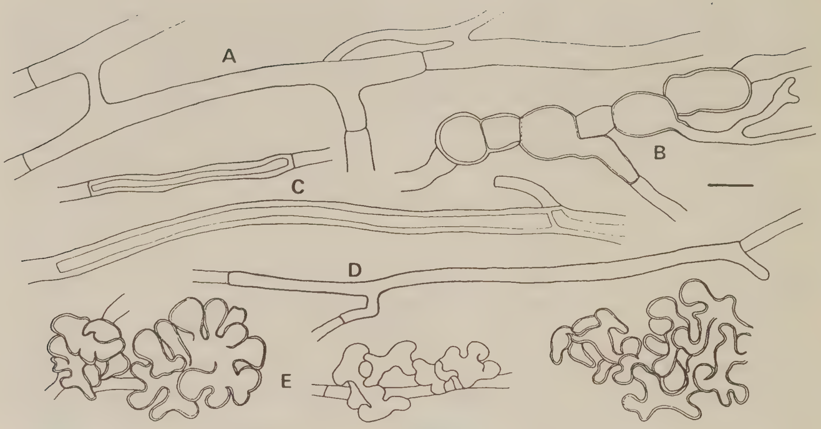


Fig. 4, *Phellinus andinopatagonicus*: Microscopic cultural features. A, generative hyphae with H-shaped anastomoses; B, hypha with short and swollen segments; C, thick-walled hyphal segments; D, hypha with slightly thickened walls and yellowish contents; E, hyphae with branched, digitiform, lateral branches. Bar = 10 µm

Species codes:
Bleaching type: 2.6.11.32.36.40.45.53.54.
Staining type : 2.6.25.32.37.39.47.53.54.

Remarks: *Phellinus andinopatagonicus* is the main white-rot species found on standing *N. pumilio* (Cwielong & Rajchenberg, 1995). It produces a white pocket rot in the roots and in the base of these trees, but in the stem a fibrous rot. *Aurantioporus albidus* Rajchenb. & Cwielong (Rajchenberg, 1995) also causes a white pocket rot in the heartwood of *N. pumilio*, *N. antarctica* and *N. dombeyi,* but this pocket rot has a different, distinct aspect, because the pockets are surrounded by dark chestnut coloured wood. Cultures of *P. livescens* (Speg.) Rajchenb., the only other Hymenochaetaceae so far known to decay standing *N. pumilio,* are easily distinguished from those of *P. andinopatagonicus* by their much slower growth, their beige-yellowish, thick aerial mats and, microscopically, by the formation of typical fiber hyphae (see below). Dimorphic strains in species of *Phellinus* Quél. are well documented (Niemelä, 1977; David et al., 1982). Stenlid & Rayner (1989) have critically reviewed the ecological meaning of culture dimorphism in *Heterobasidion annosum* (Fr.) Bref. and other Aphyllophorales. Although Deschamps & Wright (1975) presented a species code describing the culture of *P. andinopatagonicus*, they did not give details of its morphology and did not describe the dimorphism found in our study.

Phellinus livescens (Speg.) Rajchenb., Sydowia 40: 246, 1987.

Fruitbody descriptions in Wright & Deschamps (1972, sub *P. igniarius* (L.: Fr.) Quél. var. *resupinatus* Bres.) and Rajchenberg (1987).
Cultures studied: CIEFAP 10, Argentina, Chubut, Futaleufú, Huemules ravine, on standing *N. pumlio*, P. Cwielong, 25.Oct.90. CIEFAP 11, Ibid., but isolated from the associated wood-rot. CIEFAP 58, Ibid., Kaquel ranges, on standing *N. pumilio*, MR 10475, 17.May.91. CIEFAP 4, Ibid., P. Cwielong, 25.Nov.90. CIEFAP 21, Ibid., MR s.n. & P. Cwielong, 31.Jan.91.

Macroscopic characters: Mats white but turning light yellow or light chestnut yellow in age, densely cottony with a thick aerial mycelium, rarely felty (Fig. 7F); margins felty, regular or slightly irregular; growing very slowly, 4.5-5.5 cm at 6 wk. Reverse staining to dark red chestnut brown beneath the inoculum area. Odor musty.
Oxidase reactions: GAA: ++, 0 mm; TAA: ++, 0 mm; TyA: -, 0 mm.
Microscopic characters: Marginal hyphae simple septate, thin-walled, 2.5-4 µm diam. (Fig. 5A). Back from the margin, similar, branched, 1-4 µm diam., generative hyphae and rarely branched, fiber hyphae, 1-4 µm diam., are formed (Fig. 5B). On the agar surface, wider, up to 7 µm diam. generative hyphae are formed (Fig. 5C), which may present slightly thickened walls and crystal incrustations (Fig. 5D). Submerged mycelium is formed by generative hyphae with chestnut brown cytoplasmic contents and short, protuberant, digitiform hyphal branches that present slightly thickened and chestnut coloured walls and which may present cytoplasmic contents (Fig. 5E). These protuberant hyphae remain always isolated, they are insconspicuous and do not form a plectenchyma.

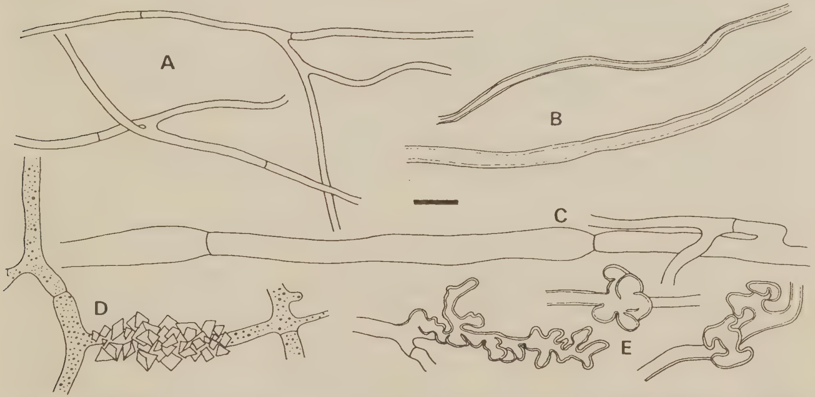


Fig. 5, *Phellinus livescens*: Microscopic cultural features. A, generative hyphae; B, fiber hyphae; C, wide generative hypha; D, incrusted generative hypha; E, digitiform branches of hyphae. Bar = 10 µm

Cytology: The hyphal segments of the polysporic cultures are multinucleate. Some assays of numbers of nuclei made starting from the terminal cell are as follows:
CIEFAP 21: 3-3-3-2-2-; 2-2-2-3-; 2-2-2-2-
CIEFAP 4: 2-2-3-2-2-; 2-2-3-3-3-; 3-3-3-3-3-; 2-2-2-2-2-

Species code: 2.6.8.32.37.39.40.47.54.

Remarks: *Phellinus livescens* decays fallen trunks of *N. dombeyi* and standing *N. pumilio*. In *N. pumilio, P. livescens* is restricted to the sapwood where it causes a fibrous white rot that is crossed by numerous dark, irregular lines(Cwielong & Rajchenberg, 1995). Its morphological differences with *P. andinopatagonicus* have been discussed above. Also, both species can be distinguished on the number of nuclei in the hyphal segments: in *P. livescens* the segments are 2-3 nucleate and in *P. andinopatagonicus* they are multinucleate. Wright & Deschamps (1972) described a culture of this species as *P. igniarius* var. *resupinatus*. Their culture differed from ours in the formation of a pseudoparenchyma.

Polyporus gayanus Lév., Ann. Sci. Nat. ser. III, 5: 54, 1846.

Fruitbody descriptions in Wright & Deschamps (1972, 1975) and Singer (1969).
Cultures studied: CIEFAP 34, Argentina, Chubut, Futaleufú, Lake Rosario, on fallen branch of *N. pumilio*, MR 10419, 26.Mar.91, isolated from the associated wood-rot. CIEFAP 12, Ibid., Kaquel Ranges, on fallen branch of *N. pumilio*, P. Cwielong, Nov.90, isolated from the associated wood-rot. CIEFAP 136, Ibid., Sierra Colorada, on fallen branch of *N. pumilio*, MR 10606, 1.Apr.92. CIEFAP 47, Ibid., Río Senguer, El Triana, on fallen branch of *N. pumilio*, MR 10442 and P. Cwielong, 15.Apr.91. CIEFAP 48, Ibid., MR 10443. CIEFAP 74, Los Alerces National Park, Cerro Dedal, on fallen branch of *N. pumilio*, MR 10454 et al.

Macroscopic characters: Mats more or less homogeneously felty-cottony, areolate, or with raised cottony spots that are surrounded with felty or subfelty mat, towards the inoculum subfelty; margin irregular, subfelty but soon raising; growing slowly, with the dishes covered at 6 wk., or very slowly, with the mycelial mat only 3.5-7.5 cm at the end of the study. Reverse bleaching. Odor musty.
Oxidase reactions: GAA: -, 0 mm; TAA: -, 0 mm; TyA: - to +++, 0 mm.
Microscopic characters: Marginal hyphae clamped, thin-walled, 4-6 µm diam. (Fig. 6A), behind leading edge forming narrower branches, 2-4 µm diam. Cottony mycelium consisting of: a) Clamped, narrow to wide, 1-5 µm diam., branched, generative hyphae, the narrow ones filiform (Fig. 6B); b) fiber hyphae,

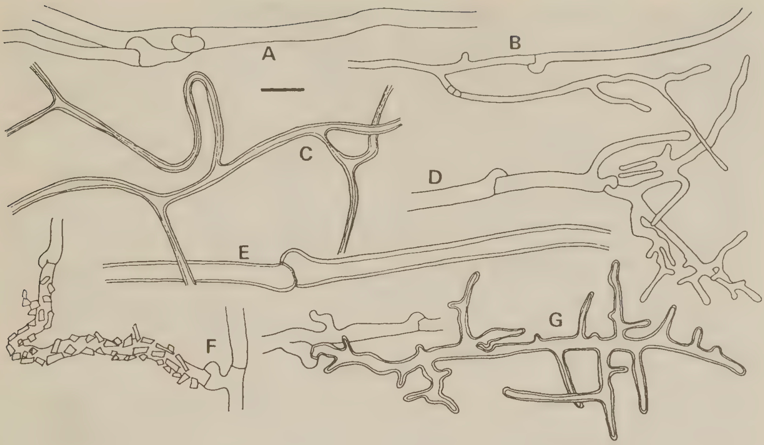


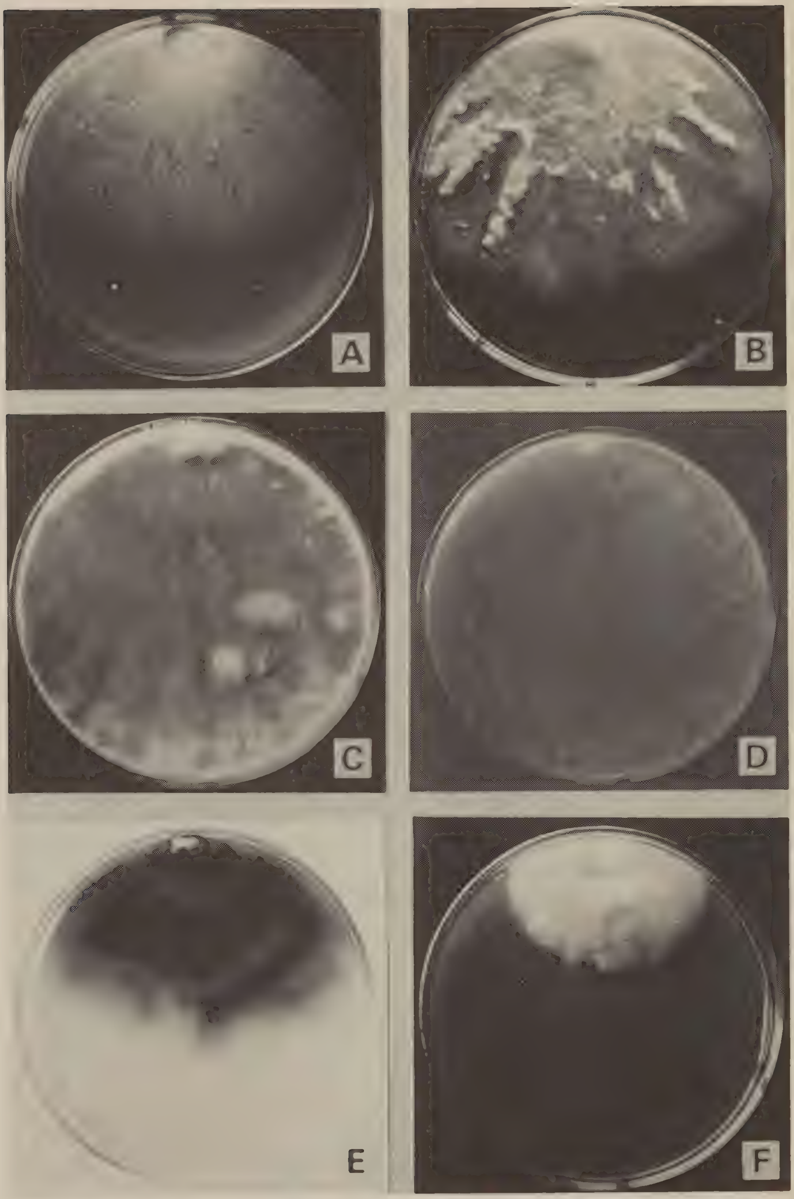
Fig. 6, *Polyporus gayanus*: Microscopic cultural features. A-B, generative hyphae; C, fiber hypha; D, generative hypha with arbuscular branches; E, thick-walled generative hypha; F, incrusted generative hypha; G, branched and thick-walled generative hypha. Bar = 10 µm.

1.0-2.5 µm diam., aseptate, much branched, with hyaline, slightly thickened walls (Fig. 6C). Mycelium on the agar surface composed of generative hyphae up to 6 µm diam., with thin to slightly thickened walls, branched, some with arbuscular branches (Fig. 6D), others unbranched and devoid of cytoplasm (Fig. 6E); few fiber hyphae are also present. Inoculum with incrusted hyphae (Fig. 6F). Culture CIEFAP 12 also produced much branched generative hyphae with thickened walls (Fig. 6G) and chestnut-colored cytoplasmatic contents in some segments.

Sexuality: tetrapolar. Eight monosporic cultures were distributed as follows:
A_1B_1: 3, 9
A_2B_2: 8
A_1B_2: 1, 2, 4, 5
A_2B_1: 7
Spores germinated after 10 days on MEA.

Species code: 1.2.3.8.(25).32.40.45-47.54.60.

Remarks: In spite of the negative results of the oxidase reactions *P. gayanus* is consistently associated with a white rot of *Nothofagus*.


A
B
C
D
E
F

Postia pelliculosa (Berk.) Rajchenb., Sydowia 40: 248, 1987.

Fruitbody descriptions in Wright & Deschamps (1972, 1975, sub *Spongipellis chubutensis* Wright & Desch.), Cunningham (1965, sub *Tyromyces*) and Buchanan & Hood (1992).

Cultures studied: CIEFAP 45, Argentina, Chubut, Futaleufú, Lake Baggilt, on fallen trunk of *N. pumilio*, MR 10439, 2.Apr.91. CIEFAP 25, Ibid., Kaquel Ranges, on standing *N. pumilio*, isolated from an incipient wood-rot, Nov.91. CIEFAP 65, Ibid., Lake Rosario, MR 10409 and P. Cwielong, 26.Mar.91. CIEFAP 66, =CIEFAP 65 but isolated from the associated wood-rot. CIEFAP 114, Ibid., Río Senguer, El Triana, on standing *N. pumilio*, MR 10632, 2.Apr.92. CIEFAP 130, Ibid., Los Alerces National Park, Río Menéndez, path to Lake Menéndez, on fallen trunk of *N. dombeyi*, MR 10592, 28.Mar.92. Neuquén, Lanín National Park, Lake Lácar, Chachín, on fallen trunk of *N. alpina*, MR 10671, 10.Apr.92. CIEFAP 61, Australia, Western Australia, Busselton, 1956 (duplicate culture from CSIRO, Clayton, Victoria, DFP 6223). CIEFAP 64: Ibid.,Victoria, Cumberland Falls, on *Nothofagus* sp., 1954 (duplicate culture of DFP 4550). CIEFAP 76, New Zealand, Taupo, Rotokuru Ecological Reserve, on *N. truncata*, J. Bedford, 3.Jul.85, P.K. Buchanan 85/272. CIEFAP 75, Ibid., South Island, Longwood St. Forest, Mitchell Rd., on fallen trunk of *N. menziesii* ?, P.K. Buchanan 85/159, 20.Apr.85. Besides, 106 cultures isolated from brown wood-rots of standing *N. pumilio* in Argentina, Chubut, Río Senguer, El Triana, Apr.91 and Lake La Plata, Mar.93 were incorporated to this study. Cultures from El Triana were named as 'ET n°' in compatibility studies.

Macroscopic characters: Mats variable: homogeneously felty, white, with scarce aerial mycelium and subfelty towards the inoculum; or homogeneously woolly, with abundant, white, aerial mycelium but subfelty towards the inoculum (Fig. 9A); or younger parts of mat felty-woolly or cottony then felty toward inoculum; or younger parts of mat felty, with scattered cottony spots that increase in number towards the inoculum (Fig. 9B); some cultures form radial, concentric or irregular sectors that present beige colored aerial mycelium; margins regular, slightly subfelty; growing moderately to slowly, dishes covered by 4-6wk. Reverse unchanged. Odor none or fruity.

Oxidase reactions: GAA: -, 25-40 mm; TAA: - to +, 20-35 mm; TyA: -, 0-tr.

Microscopic characters: Marginal hyphae clamped, 3-6 µm diam., with hyaline, thin to thickened walls (Fig. 8A). Aerial mycelium of 'typical' cultures develop characteristic generative hyphae with homogeneously thickened walls that, in some cases, retain a thin 'thread' of cytoplasm (Fig. 8B). 'Typical' cultures also form a few generative hyphae with irregularly thickened walls, which may be easily overlooked, 5-6 µm diam. (Fig. 8D). Chlamydospores subglobose,

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Fig. 7, Aspects of the mats of several polypores of the Patagonian Andes forests, at week 6: A, *Fistulina hepatica* (CIEFAP 33). B, *Grifola sordulenta* (CIEFAP 154). C, *Macrohyporia dictyopora* (CIEFAP 108). D, *Phellinus andinopatagonicus*, bleaching type (CIEFAP 14). E, *Phellinus andinopatagonicus*, staining type (CIEFAP 14). F, *Phellinus livescens* (CIEFAP 10). Dishes are 9 cm in diam.

pyriform, ellipsoid, sometimes truncate, intercalary or terminal, 8-15 x 4-6 µm, occassional (Fig. 8E). In the inoculum, generative hyphae with long incrusted segments (Fig. 8C). 'Atypical' cultures lack or rarely have generative hyphae with thickened walls, and lack hyphae with irregularly thickened walls. Some cultures form generative hyphae with slightly thickened and rugose walls (Fig. 8F). Sectors with beige-colored aerial mat develop generative hyphae with chestnut brown walls and cytoplasmic contents. Exceptionally, hyphae with intercalary swellings are formed.

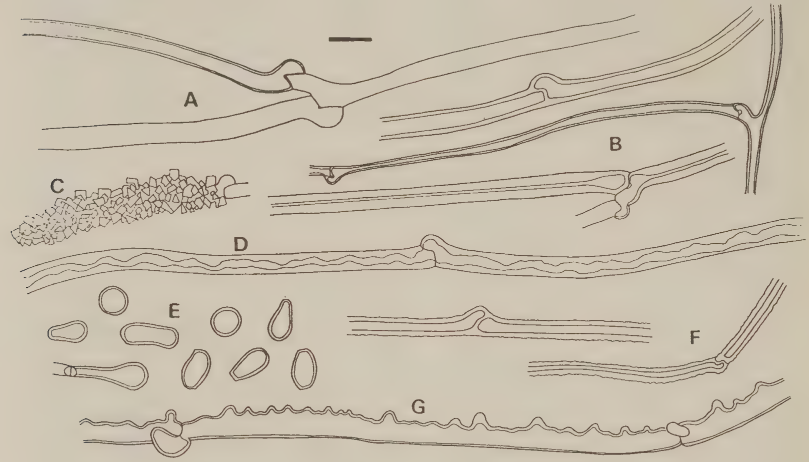

Fig. 8, *Postia pelliculosa*: Microscopic cultural features. A, generative hypha of the advancing mycelium; B, thick-walled generative hyphae; C, incrusted hyphal segment; D, generative hypha with irregularly thickened walls; E, chlamydospores; F, thick-walled hyphae with outer rugose walls, G, generative hypha with short, lateral, thick-walled evaginations. Bar = 10 µm.

Nuclear behavior: normal, i.e., spores are uninucleate, the monosporic cultures are uninucleated and the polysporic mycelium is dikaryotic. Spores germinate after 7-10 days on MEA.

Sexuality: probably tetrapolar. Two cultures, CIEFAP 130 (from Argentina) and CIEFAP 76 (from New Zealand), sporulated in culture conditions. Seven monosporic cultures from CIEFAP 130 were distributed as follows:
A_1B_1: 1, 3, 7 A_2B_2: 4, 5, 6 A_xB_x: 2
Ten monosporic cultures from CIEFAP 76 were mated in all the combinations but none of them formed clamps.

Species code: 1.3.(9).27.(31c).(34).36.38.44-46.(48).(50).54.60.61.

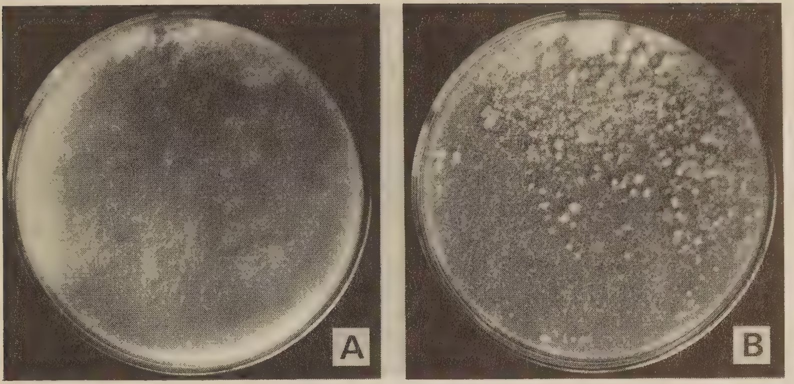

Fig. 9, Aspects of the mats of *Postia pelliculosa*, at week 6: A, CIEFAP 65. B, CIEFAP 114. Dishes are 9 cm in diam.

Compatibility tests

Compatibility tests were performed between Argentinian, New Zealand and Australian strains. Mono and polysporic cultures were used to perform two types of tests (Hallenberg, 1984): a) Mono x mono mating tests and b) Poly x mono mating tests (Buller phenomenon). Results are shown in Tables 1 and 2. Mating tests between monosporic cultures of 'typical' *P. pelliculosa* cultures and 'atypical' polysporic cultures obtained from wood-rots found in standing *N. pumilio* in Argentina were also performed in order to verify their identity. Results are shown in Table 3.

The positive results obtained in the mating tests between the monosporic strains of Argentina and New Zealand (Table 1) and the high degree of dikaryotization in the di x mono compatibility tests (Table 2) support the conspecifity of the specimens of either side of the Pacific Ocean. Therefore, *Spongipellis chubutensis* Wright & Deschamps (1972, 1975), described from the Patagonian Andes of Argentina, is synonymous with *Postia pelliculosa*, described from Tasmania (Australia) and also known from New Zealand (Cunningham, 1965; Buchanan & Hood, 1992), as suggested by Hjortstam & Ryvarden (1985). The compatibility test of 'typical' and 'atypical' strains of *P. pelliculosa* also resulted in a high degree of dikaryotizacion (85%) indicating conspecificity. Thus, the morphological variation shown by these strains must be evaluated at the species level.

Table 1. *Postia pelliculosa*: Compatibility tests between monosporic cultures from Argentina (CIEFAP 130) and from New Zealand (CIEFAP 76).

+: clamp formation in all the dish

4, 5, 6: monosporic cultures with mating type unknown

		Postia pelliculosa NEW ZEALAND 76		
		4	5	6
Postia pelliculosa ARGENTINA 130	$A_1B_1/7$	+	+	+
	$A_2B_2/5$	+	+	+
	$A_XB_X/2$	+	+	+

Remarks : Cultures of *P. pelliculosa* were roughly designated as 'typical'or 'atypical'. 'Typical' cultures were characterized by the combination of thick, felty or woolly aerial mat, that in the tubes readily form a tuft of light chestnut mycelium that grows over the slant, generative hyphae with homogeneously thickened walls and hyphae with irregularly thickened walls, chlamydospores and a weak positive TAA reaction. Cultures from Australia (CIEFAP 61 and 64) differed in forming hyphae with lateral, short, thick-walled evaginations (Fig. 7G). Cultures from New Zealand (CIEFAP 71 and 76) lacked any type of hyphae with thick walls. Many cultures isolated from rotted wood of standing *N. pumilio* lacked the 'typical' features of this species and were designated as 'atypical'. Their mats were not as thick and few or no hyphae with wall thickenings were formed.

Wright & Deschamps (1972) studied the cultural features of two strains of this species. They considered the oxidase reactions as positive but we disagree. Our strains were either negative or weakly positive on TAA. In addition all our strains were associated with a brown rot. The oxidase reactions or lack of one is important in determining the taxonomic disposition of this species. If a white-rotter, the species could be classified in *Spongipellis* Pat. Whereas, the combination of producing a brown rot and having a monomitic hyphal system with clamped generative hyphae supports the disposition in *Postia* Fr. (Rajchenberg, 1987). *Postia pelliculosa* is distinguished by the thick-walled spores, the ochraceous context and the relatively rapid germination of the spores. Typical species of *Postia* are characterized by white fruitbodies and thin walled spores that take 3-4 weeks to germinate (David, 1980). *Postia pelliculosa* is the main wood-rotting species of standing *N. pumilio* in Patagonia, causing about 50% of its decay (Cwielong & Rajchenberg, 1995). Our results, which include the variation observed in a number of strains, provide a basis for identifying cultures isolated from decayed wood.

Table 2. *Postia pelliculosa*: Di x mono compatibility tests between polysporic cultures from Argentina, Australia and New Zealand and monosporic cultures from New Zealand and Argentina. Numbers refer to CIEFAP cultures. Results show the presence or absence of clamps at the opposite side where the polysporic strain was inoculated.

+: presence of clamps, i.e. dikaryotization of the monosporic mat

- : absence of clamps, i.e. dikaryotization of the monosporic mat did not occur

f: false clamps, i.e. dikaryotization is incomplete

T wk: number of weeks from confrontation of the mycelia to observation

				Postia pelliculosa Monosporic cultures				
				NEW ZEALAND			ARGENTINA	
			T wk	76/4	76/5	76/6	130 A_xB_x	130 A_1B_1
Postia pelliculosa Polysporic cultures	NEW ZEALAND	75	8	+	+	+	-	
			12	+	+	+	+	
		76	8	-	f	+	-	+
			12	-	+	+	+	+
			15	+	+	+	+	+
	AUSTRALIA	64	8	f	+	+	+	+
			12	+	+	+	+	+
		61	8	-	-	-	-	-
			12	-	-	-	-	-
			15	-	-	-	-	-
	ARGENTINA	45	6	-	-	+	+	+
			8	-	-	+	+	+
			12	+	-	+	+	+
			15	+	+	+	±	+
		114	8	-	-	+		
			12	+	-	+		
			15	+	-	+		
		66	6	+	-	-	-	+
			12	+	+	-	-	+
			15	+	+	+	+	+
		130	8				+	+

Table 3: *Postia pelliculosa*: Di x mono compatibility tests between 'atypical' polysporic cultures from El Triana, Chubut,Argentina (ET) and 'typical' monosporic cultures from Argentina and New Zealand. Numbers refer to CIEFAP cultures. Results show the presence or absence of clamps at the opposite side where the polysporic strain was inoculated.

+: presence of clamps, i.e. dikaryotization of the monosporic mat

- : absence of clamps, i.e. dikaryotization of the monosporic mat did not occur

T wk: number of weeks passed since the confrontation of the mycelia and the observation

'Atypical' polysporic cultures ET-Argentina	'Typical' monosporic cultures	Time after confrontation	
		8 weeks	16 weeks
1-1	130	-	+
10-2A	$A_1B_1/2$	+	+
14-2A		-	+
14-3B	Argentina	±	+
31-2		+	+
66-1B		-	+
17-1A	130	-	-
21-4	$A_xB_x/7$	-	+
35-1A		-	+
44-2A	Argentina	-	±
53-3		-	-
69-2A		-	-
14-3B	76/5	+	+
17-3A		-	±
25-2A	New Zealand	-	±
25-3B		+	+
35-1A		±	+
35-3		-	+
44-2A		+	+
45-3B		+	+
53-3		-	+
54-1		+	+
66-1B		-	-
72-3		-	+

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MELIOLACEAE EXSICCATAE IN HERBARIUM CRYPTOGAMAE INDIAE ORIENTALIS

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SUMMARY

Herbarium Cryptogamae Indiae Orientalis houses more than 40,000 fungal collections. Of those, 595 collections are of Meliolaceae belonging to 417 species and infra-specific taxa; *Amazonia* - 18, *Appendiculella* - 3, *Armatella* - 8, *Asteridiella* - 33, *Diporotheca* - 1, *Irenopsis* - 15, *Meliola* - 339 and *Prataprajella* - 1.

Key words: Meliolaceae; exsiccatae, herbarium

The Herbarium Cryptogamae Indiae Orientalis (HCIO) was established by Sir Edwin John Butler in 1905 at Pusa, Bihar. Because of the earthquake in 1934, this herbarium was shifted to New Delhi. This is one of the biggest herbaria in eastern Asia with more than 40,000 fungal exsiccatae belonging to 3550 genera including more than 4000 type materials.

An attempt has been made here to list the Meliolaceae exsiccatae housed in HCIO. We have followed here Mueller & von Arx (1971) in listing all the species of the Meliolaceae genera: *Amazonia, Appendiculella, Armatella, Asteridiella, Diporotheca, Irenopsis, Meliola* and the recently described genus, *Pratapajella*. The synonyms provided herein are the names written on the herbarium materials and the recent names are based on the published data of Hansford (1961) and others. A detailed revision of Indian Meliolales will be published in due course.

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On *Abarema bigemina* (Mimosaceae), Chenganacherry, Kerala, Dec. 1986, V.T. Antony HCIO 40462(type).

Amazonia abutili Hosagoudar, Crypt. Bot. 2/3: 183, 1991.
On *Abutilon ramosum* (Malvaceae), Valparai, Tamil Nadu, Jan. 25, 1990, V.B. Hosagoudar HCIO 30354 (type).

Amazonia acronychiae Hosagoudar in Hosagoudar & Goos, Mycotaxon 36: 230, 1989.
On *Acronychia pedunculata* (Rutaceae), Idukki, Kerala, June 12, 1983, V.B. Hosagoudar HCIO 40463 (type).

Amazonia actinodaphnes Hosagoudar in Hosagoudar & Goos, Mycotaxon 36: 230, 1989.
On *Actinodaphne hookeri* (Lauraceae), Idukki, Kerala, Oct. 11, 1982, V.B. Hosagoudar HCIO 40465 (type).

Amazonia balakrishnanii Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 404, 1990.
On *Castanopsis armata* (Fagaceae), Assam, Jan. 1887, G. Mann HCIO 39434 (type, p.p.).

Amazonia daphniphylli Patil in Hosagoudar, Patil & Balakrishnan, J. Econ. Tax. Bot. 13: 78, 1989.
On *Daphniphyllum neilgherrense* (Daphniphyllaceae), Kodaikanal, Tamil Nadu, Nov. 29, 1987, R.S. Sawant HCIO 39883 (type).

Amazonia flacourtiae Hosagoudar, Siddappa & Udaiyan, Nova Hedwigia 56: 193, 1993.
On *Flacourtia* sp. (Flacourtiaceae), Nilgiris, Tamil Nadu, Feb. 16, 1991, V.B. Hosagoudar HCIO 30617 (type).

Amazonia gouaniae Hosagoudar & Braun, Crypt. Bot. 1: 56, 1989.
On *Gouania microcarpa* (Rhamnaceae), Gudulur, Nilgiris, Tamil Nadu, March 11, 1969, D.B. Deb HCIO 40464(type).

Amazonia grewiae Patil, sp. nov. *(in ed.)*.
On *Grewia asiatica* (Tiliaceae), Castle rock, Karnataka, Jan 10, 1984, C.R. Patil HCIO 40029 (type).
Note: Host identity is questionable.

Amazonia henryi Hosagoudar, J. Econ. Tax. Bot. 12: 246, 1988.
On *Combretum decandrum* (Combretaceae), Warangal, Andhra Pradesh, Feb. 26, 1963, A.N. Henry HCIO 39301(type).

Amazonia leeae Hansf. & Thirum., Farlowia 3: 287, 1948.
On *Leea macrophylla* (Leeaceae), Balehonnur, Karnataka, April 29, 1945, M.J. Thirumalachar HCIO 10870 (type); *L. indica*, Gersoppa, Karnataka, Sept. 24, 1992, P.A. Raghu HCIO 40746.

Amazonia mayteni Hosagoudar *et al.* (*in ed.*).
On *Maytenus rothiana* (Celastraceae), Gersoppa, Karnataka, Oct. 20, 1992, P.A. Raghu HCIO 40853 (type).

Amazonia oleae Patil (*in ed.)*
On *Olea dioica* (Oleaceae), Koyna, Satara, Maharashtra, Dec. 6, 1984, C.R. Patil HCIO 40030 (type).

Amazonia peregrina Sydow, Ann. Mycol. 15: 238, 1917.
On *Maesa indica* (Myrsinaceae), Idukki, Kerala, Jan. 10, 1982, V.B. Hosagoudar HCIO 40467; Anamalai, Coimbatore, Dec. 27, 1990, V.B. Hosagoudar HCIO 30513.

Amazonia psychotriae (Henn.) Theiss., Ann. Mycol. 11: 499, 1913.
On *Psychotria* sp. (Rubiaceae), Agumbe, Karnataka, May 7, 1992, C.M. Pillai HCIO 30987.

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On *Embelia viridifolia* (Myrsinaceae), Gagambawada, Maharashtra, May 1, 1984, D.B. Pawar HCIO 36385.

Amazonia syzygii Hosagoudar in Hosagoudar & Goos, Mycotaxon 34: 236, 1989.
On *Syzygium cumini* (Myrtaceae), Idukki, Kerala, Dec. 13, 1982, V.B. Hosagoudar HCIO 40469 (type); Anamalai, Coimbatore, Tamil Nadu, Dec. 27, 1990, V.B. Hosagoudar HCIO 30514; *Syzygium* sp., Sampaje , Kodagu, Karnataka, Dec. 22, 1991, B.R. Dayal HCIO 30841.

Amazonia turbinatae Patil (*ined.*).
On *Bridelia retusa* (Euphorbiaceae), Patgaon, Kolhapur, Maharashtra, Feb. 17, 1984, C.R. Patil HCIO 40027 (type), 40028 (isotype).

Appendiculella calophylli (Stev.) Toro var. ***apetali*** Hosagoudar ***et al.*** *(in ed.)*
On *Calophyllum apetalum* (Clusiaceae), Gersoppa, Karnataka, Oct. 24, 1992, P.A. Raghu HCIO 40854 (type).

Appendiculella calostroma (Desm.) Hoehnel, Sitz. K. Akad. Wiss. Wien. Math. naturw. Kl. 138: 556, 1919.
On *Crataegus crenulata* (Rosaceae), Chaubattia, Uttar Pradesh, Oct. 15, 1959, J.N. Kapoor HCIO 28331; *Rubus ellipticus* (Rosaceae), Kalimpong, West Bengal, March 19, 1957, Collector unknown HCIO 26605.

Appendiculella paramignyae Thite (*in ed.*).
On *Paramignya monophylla* (Rutaceae), Anmode, Maharashtra, Oct. 1974, A.N. Thite HCIO 31913 (type).

Armatella balakrishnanii Hosagoudar, J. Econ. Tax. Bot. 15: 196, 1991.
On *Cinnamomum malabatrum* (Lauraceae), Idukki, Kerala, April 18, 1982, V.B. Hosagoudar HCIO 40470(type).

Armatella cinnamomi Hansf. & Thirum., Farlowia 3: 286, 1948.
On *Cinnamomum zeylanicum* (Lauraceae), Balehonnur, Karnataka, April 27, 1945, M.J. Thirumalachar HCIO 10869(type).

Armatella cinnamomicola Hansf.,Reinwardtia 3: 87, 1954.
On *Cinnamomum malabatrum* (Lauraceae), Nilgiris, Tamil

Nadu, Jan. 25, 1990, V.B. Hosagoudar HCIO 30355; Pudukadu, Tamil Nadu, Jan. 17, 1987, V.B. Hosagoudar HCIO 39302.

Armatella cryptocaryae Hosagoudar, J. Econ. Tax. Bot. 15: 198, 1991.
On *Cryptocarya bourdilloni* (Lauraceae), Pamba, Kerala, Oct. 10, 1983, V.B. Hosagoudar HCIO 40471(type).

Armatella indica Hosagoudar, J. Econ. Tax. Bot. 15: 199, 1991.
On *Cinnamomum malabatrum* (Lauraceae), Idukki, Kerala, Oct. 5, 1983, V.B. Hosagoudar HCIO 40472(type).

Armatella katumotoi Hosagoudar, Sydowia 40: 113, 1987.
On *Persea macrantha* (Lauraceae), Anamalai, Coimbatore, Tamil Nadu, Jan. 17, 1987, V.B. Hosagoudar HCIO 39303 (type).

Armatella litseae (Henn.) Theiss. & Sydow, Ann. Mycol. 13: 235, 1915.
On *Neolitsea zeylanica* (Lauraceae), Idukki, Kerala, Dec. 6, 1983, V.B. Hosagoudar HCIO 40474; Mahabaleshwar, Maharashtra, July 24, 1980, M.S. Patil HCIO 36387.

Armatella phoebecola Hosagoudar, J. Econ. Tax. Bot. 15: 201, 1991.
On *Phobe lanceolata* (Lauraceae), Idukki, Kerala, Dec. 12, 1982, V.B. Hosagoudar HCIO 40473(type).

Asteridiella acronychiae-pedunculatae Hosagoudar in Hosagoudar & Goos, Mycotaxon 42: 126, 1991.
On *Acronychia pedunculata* (Rutaceae), Top slip, Coimbatore, Tamil Nadu, Dec. 20, 1990, V.B. Hosagoudar HCIO 30515 (type).

Asteridiella americana Hansf., Sydowia 10: 21, 1957
On *Olea dioica* (Oleaceae), Amboli, Maharashtra, Dec. 3, 1976, M.S. Patil HCIO 32526; *Linociera malabarica* (Oleaceae), Idukki, Kerala, Dec. 28, 1983, V.B. Hosagoudar HCIO 39391.

Asteridiella anamalaiana Hosagoudar in Hosagoudar & Goos, Mycotaxon 42: 127, 1991.
On *Sterculia urens* (Sterculiaceae), Valparai, Coimbatore, Tamil Nadu, Dec. 23, 1990, V.B. Hosagoudar 30529 (type).

Asteridiella callicarpae (Stev. & Rold.) Hansf., Sydowia 10: 47, 1957.
On *Callicarpa lanata* (Verbenaceae), Castle rock, Karnataka, Jan. 10, 1984, C.R. Patil HCIO 40031.

Asteridiella callista (Rehm) Hansf., Sydowia 40: 47, 1957.
Meliola callista Rehm, Leafl. Philipp. Bot. 6: 2191, 1957.
On *Premna cumingiana* (Verbenaceae), Luzon, March 1916, H.S. Yates HCIO 3218; *P. nauscosa*, Luzon, Nov. 1915, M. Ramos HCIO 3219; *P. odorata*, Luzon, April 1916, H.S. Yates HCIO 3220.

Asteridiella clerodendricola Hosagoudar in Hosagoudar & Goos, Mycotaxon 36: 237, 1989.
On *Clerodendrum viscosum* (Verbenaceae), Idukki, Kerala,

Dec. 22, 1983, V.B. Hosagoudar HCIO 40475 (type); Seithur hills, Kamarajar dist., Nov. 12, 1992, V.B. Hosagoudar HCIO 40855.

Asteridiella combreti (Stev.) Hansf. var. ***leonensis*** Hansf., Sydowia Beih. 2: 160, 1961.
On *Terminalia paniculata* (Combretaceae), Idukki, Kerala, Dec. 13, 1982, V.B. Hosagoudar HCIO 40476.

Asteridiella confragosa (Sydow & Sydow) Hansf., Sydowia 10: 47, 1957.
On *Trichosanthus palmata* (Cucurbitaceae), Idukki, Kerala, Oct. 8, 1983, V.B. Hosagoudar HCIO 40477.

Asteridiella crotonis Hosagoudar in Hosagoudar & Goos, Mycotaxon 36: 239, 1989.
On *Croton reticulatus* (Euphorbiaceae), Pamba, Kerala, Oct. 10, 1989, V.B. Hosagoudar HCIO 40478 (type).

Asteridiella cyclopoda (Stev.) Hansf., Sydowia 10: 47, 1957.
On *Vernonia monosis* (Asteraceae), Idukki, Kerala, Oct. 6, 1983, V.B. Hosagoudar HCIO 40479; Valparai, Coimbatore, Dec. 12, 1990, V.B. Hosagoudar HCIO 30516.

Asteridiella cyrtandrae (Stev.) Hansf. var. ***didymocarpi*** Hosagoudar (*in ed.*).
On *Didymocarpus humboltianus* (Gesneriaceae), Seithur hills, Kamarajar dist., Tamil Nadu, Oct. 13, 1993, V.B. Hosagoudar HCIO 40747 (type).

Asteridiella ehretiae Hosagoudar & Raghu in Hosagoudar, Raghu & Pillai, Nova hedwigia 58: 530, 1994.
On *Ehretia canarensis* (Boraginaceae), Gersoppa, Karnataka, May 23, 1992, P.A. Raghu HCIO 40748 (type).

Asteridiella elaeocarpi-tuberculati Hosagoudar, Crypt. Bot. 2/3:183, 1991.
On *Elaeocarpus tuberculatus* (Elaeocarpaceae), Nilgiris, Tamil Nadu, Jan. 29, 1990, V.B. Hosagoudar 30357 (type).

Asteridiella entebbeensis (Hansf. & Stev.) Hansf., Sydowia 10: 48, 1957.
On *Macaranga peltata* (Euphorbiaceae), Valparai, Coimbatore, Tamil Nadu, March 23, 1990, V.B. Hosagoudar HCIO 30380.

Asteridiella formosensis (Yamam) Hansf. Sydowia 10: 48, 1957.
On *Callicarpa tomentosa* (Verbenaceae), Pamba, Kerala, Oct. 10, 1983, V.B. Hosagoudar HCIO 40480; Anamalai, Coimbatore, Tamil Nadu, Dec. 21, 1990, V.B. Hosagoudar HCIO 30517; Gersoppa, Karnataka, Oct. 25, 1992, P.A. Raghu HCIO 40856.

Asteridiella gymnosporiae (Sydow) Hansf., Sydowia 10: 48, 1957.
Meliola gymnosporiae Sydow, Ann. Mycol. 10: 79, 1912.
On *Gymnosporia spinosa* (Celastraceae), Manilla, Luzon, Jan. 1913, E.D. Merril HCIO 3274, 3275; *G. montana*, Zolambi, Sangli, Maharashtra, March 29, 1991, C.R. Patil HCIO 30804;

Amboli, Maharashtra, Feb. 13, 1977, M.S. Patil HCIO 32525.

Asteridiella leucosykeae (Yates) Hansf., Sydowia 10: 49, 1957.
Meliola leucosykeae Yates, Philippine J. Sci. 12: 369, 1917.
On *Leucosyke capitellata* (Urticaceae), Catubig River, Samar, Feb.-March, 1916, M. Ramos HCIO 3303.

Asteridiella linocieriae (Sydow) Hansf., Sydowia 10: 48, 1957.
On *Olea dioica* (Oleaceae), Castle Rock, 23, Oct. 1970, P.G. Patwardhanan & G.T. Joshi HCIO 31274.

Asteridiella lophopetali Hosagoudar & Raghu, New Botanist 20: 65, 1993.
On *Lophopetalum wightianum* (Celastraceae), Gersoppa, Uttara Kannada, Karnataka, Oct. 22, 1992, P.A. Raghu HCIO 40857 (type).

Asteridiella macarangicola Hosagoudar in Hosagoudar & Goos, Mycotaxon 36: 240, 1989.
On *Macaranga peltata* (Euphorbiaceae), Idukki, Kerala, Dec. 24, 1983, V.B. Hosagoudar HCIO 40481 (type).

Asteridiella malloti (Hansf. & Thirum.) Hansf., Sydowia 10: 49, 1957.
On *Mallotus alba* (Euphorbiaceae), Balehonnur, Karnataka, Sept. 24, 1944, M.J. Thirumalachar HCIO 10860 (type); *M. philippinensis,* Idukki, Kerala, Dec. 25, 1983, V.B. Hosagoudar HCIO 40482.

Asteridiella malloticola (Yamam.) Hansf., Sydowia 10: 49, 1957.
On *Mallotus philippinensis* (Euphorbiaceae), Valparai, Coimbatore, Tamil Nadu, Dec. 23, 1990, V.B. Hosagoudar HCIO 30518.

Asteridiella pothodis (Hansf. & Thirum.) Hansf., Sydowia 10: 49,1957.
On *Pothos scandens* (Araceae), Thirthahalli, Karnataka, April 4, 1945, M.J. Thirumalachar HCIO 10862 (type).

Asteridiella sapotacearum Hansf., Sydowia 10: 50, 1957.
On *Madhuca longifolia var. latifolia* (Sapotaceae), Sampaje, Kodagu, Karnataka, Dec. 22, 1991, B.R. Dayal HCIO 30829.

Asteridiella schlegeliae (Stev.) Hansf. var. ***stereospermi*** Hosagoudar & Raghu in Hosagoudar, Raghu & Pillai, Nova Hedwigia 58: 531, 1994.
On *Stereospermum colais* (Bignoniaceae), Gersoppa, Karnataka, May 24, 1992, P.A. Raghu HCIO 40749 (type).

Asteridiella subapoda (Sydow) Hansf., Sydowia 10: 50, 1957.
Meliola subapoda Sydow, Ann. Mycol. 12: 547, 1914.
On *Mallotus philippinensis* (Euphorbiaceae), Luzon, Sept. 1913, M. Ramos HCIO 3381.

Asteridiella terminaliae (Hansf. & Deight.) Hansf., Sydowia 10: 50, 1957.

On *Terminalia chebula* (Combretaceae), Radhanagari, Maharashtra, Oct. 1971, A.N. Thite HCIO 31914.

Asteridiella theae Sawant (*in ed.*).
On *Thea sinensis* (Theaceae), Kodaikanal, Tamil Nadu, Jan. 12, 1989, R.S. Sawant HCIO 30339 (type).

Asteridiella umirayensis (Yates) Hansf., Sydowia 10: 51, 1957.
Meliola umirayensis Yates, Philippine J. Sci. 13: 370, 1918.
On *Ficus* sp. (Moraceae), Umiray, Prov. of Tayabas, Luzon, May-June 1917, M. Ramos & G. Edano HCIO 3391.

Asteridiella uncariae (Rehm) Hansf., Sydowia 10: 51, 1957.
Meliola uncariae Rehm., Leafl. Philippine Bot. 6: 2192, 1914.
On *Uncaria perrottitti* (Naucleaceae), Mt. Maquiling, Prov. of Laguna Luzon, April, 1916, Grafff HCIO 3392.

Asteridiella viburni (Sydow) Hansf., Sydowia 10: 51, 1957.
Meliola viburni Sydow, Ann. Mycol. 15: 193, 1917.
On *Viburnum odoratissimum* (Caprifoliaceae), Luzon, March-May 1916, H.S. Yates HCIO 3393.

Asteridiella vilis (Sydow) Hansf., Sydowia 10: 51, 1957.
On *Callicarpa lanata* (Verbenaceae), Zolambi, Chandoli, Sangli, Maharashtra, March 29, 1991, C.R. Patil HCIO 30803.

Asteridiella vivekananthanii Hosagoudar, Sydowia 40: 114, 1987.
On *Clerodendrum viscosum* (Verbenaceae), Valparai, Coimbatore, Tamil Nadu, Dec. 23, 1990, V.B. Hosagoudar HCIO 30519 (type); Jan. 17, 1987, V.B. Hosagoudar HCIO 39305; Seithur hills, Kamarajar dist., Tamil Nadu, Nov. 12, 1992, V.B. Hosagoudar HCIO 40861.

Asteridiella websteri Hosagoudar, Nova Hedwigia 52: 498, 1991.
On *Olea dioica* (Oleaceae), Cinchona plots, Anamalai, Coimbatore, Tamil nadu, March 24, 1990, V.B. Hosagoudar HCIO 30379 (type).

Diporotheca litseae Patil in Hosagoudar, Patil & Balakrishnan, J. Econ. Tax. Bot. 13: 80, 1989.
On *Litsea* sp. (Lauraceae), Kodaikanal, Tamil Nadu, Nov. 29, 1987. R.S. Sawant HCIO 39884 (type).

Irenopsis benguetensis Stev. & Rold. ex Hansf., Sydowia 26: 311, 1963.
On *Ficus exasperata* (Moraceae), Anamalai, Coimbatore, Tamil Nadu, Dec. 29, 1990, V.B. Hosagoudar HCIO 30520; *F. tinctoria* ssp. *gibbosa* var. *cuspidifera*, Anamalai, Dec. 23, 1990, V.B. Hosagoudar HCIO 30521.

Irenopsis chukrasiae Hosagoudar in Hosagoudar, Raghu & Pillai, Nova Hedwigia 58: 532, 1994.
On *Chukrasia tabularis* (Meliaceae), Seithur hills, Kamarajar dist., Sept. 9, 1992, V.B. Hosagoudar HCIO 40750 (type).

Irenopsis coimbatorica Hosagoudar, Pillai & Raghu, (*in ed.*).
On *Grewia* sp. (Tiliaceae), Coimbatore, Tamil Nadu, Oct. 27, 1990, V.B. Hosagoudar HCIO 30988 (type).

Irenopsis eriolaenae Hosagoudar in Hosagoudar & Goos, Mycotaxon 36: 242, 1989.
On *Eriolaena quinquelocularis* (Sterculeaceae), Idukki, Kerala, Dec. 23, 1983, V.B. Hosagoudar HCIO 40487 (type).

Irenopsis helicteridis Hosagoudar, Crypt. Bot. 2/3: 184, 1991.
On *Helicteres isora* (Sterculeaceae), Nilgiris, Tamil Nadu, Jan. 24, 1990, V.B. Hosagoudar HCIO 30358 (type).

Irenopsis leeae Hansf. var. ***indica*** Hosagoudar in Hosagoudar & Goos, Mycotaxon 36: 243, 1989.
On *Leea indica* (Leeaceae), Idukki, Kerala, Dec. 17, 1982, V.B. Hosagoudar HCIO 40488 (type).

Irenopsis leeae Hansf var. ***javensis*** Hansf. Reinwardtia 3: 110, 1954.
On *Leea indica* (Leeaceae), Anamalai, Coimbatore, Tamil Nadu, March 28, 1990, V.B. Hosagoudar HCIO 30384 (type).

Irenopsis molleriana (Wint.) Stev., Ann. Mycol. 25: 437, 1927.
On *Triumfetta halthemia* (Tiliaceae), Sriladam, West Sikkim, April 7, 1962, J.N. Kapoor HCIO 28362.

Irenopsis mudumalaiense Hosagoudar, Crypt. Bot. 2/3: 184, 1991.
On *Kydia calycina* (Malvaceae), Nilgiris, Tamil Nadu, Jan. 24, 1990, V.B. Hosagoudar HCIO 30359 (type).

Irenopsis paulensis Hansf., Proc. Linn. Soc. London 165: 167, 1955.
On *Croton* sp. (Euphorbiaceae), Valparai, Coimbatore, Tamil Nadu, March 24, 1990, V.B. Hosagoudar HCIO 30385.

Irenopsis sidae (Rehm) Hughes, Mycol, Pap. 48: 44, 1952.
On *Sida carpinifolia* (Malvaceae), Prov. of Rizal, Luzon, Dec. 1915, M. Ramos HCIO 3376, 3377; *S. cordata*, Nilgiris, Tamil Nadu, Jan. 25, 1990, V.B. Hosagoudar HCIO 30360.

Irenopsis thespesiae Hansf., Reinwardtia 3: 91, 1954.
On *Thespesia lampas* (Malvaceae), Valparai, Coimbatore, Tamil Nadu, Dec. 26, 1990, V.B. Hosagoudar HCIO 30523.

Irenopsis tjibodense Hansf., Reinwardtia 3: 106, 1954.
On *Pterospermum diversifolium* (Sterculiaceae), Gersoppa, Karnataka, Oct. 22, 1992, P.A. Raghu HCIO 40862.

Irenopsis triumfettae (Stev.) Hansf. & Deight., Mycol. Pap. 23: 14, 1948.
On *Triumfetta pilosa* (Tiliaceae), Idukki, Kerala, Dec. 15, 1982, V.B. Hosagoudar HCIO 40489; *T. rhomboidea* , Valparai, Coimbatore, Tamil Nadu, Dec. 25, 1990, V.B. Hosagoudar HCIO 30525.

Irenopsis xanthophylli Hosagoudar in Hosagoudar & Goos, Mycotaxon 42: 129, 1991.
On *Xanthophyllum flavescens* (Xanthophyllaceae), Valparai, Coimbatore, Tamil Nadu, Dec. 26, 1990, V.B. Hosagoudar 30526 (type).

Meliola abietis (Cooke) Sacc., Syll. Fung. 1: 69, 1892.
On *Abies grandis* (Pinaceae), Lake Chelan, Washington, Aug. 25, 1916, Weir HCIO 3179.

Hansford (1961) included this species under species excludendae.

Meliola abrupta Sydow, Ann. Mycol. 15: 181, 1917.
M. derridis Yates, Philippine J. Sci. 13: 368, 1918.
On *Derris* sp. (Fabaceae), Burgos, Prov.of Ilocos Norte, Luzon, Feb.-March, 1917, M. Ramos HCIO 3255; Prov. of Rizal, Luzon, Dec. 1915, M. Ramos HCIO 3180, 3181.

Meliola acanthacearum Hansf., Proc, Linn. Soc. London 157: 183, 1946.
On *Dicliptera zeylanica* (Acanthaceae), Amboli, Maharashtra, Dec. 2, 1978, M.S. Patil HCIO 36744.

Meliola acanthacearum Hansf. var. ***occidentalis*** Sydowia 11: 50, 1957.
On *Rungia sisparensis* (Acanthaceae), Idukki, Kerala, Dec. 29, 1983, V.B. Hosagoudar HCIO 40491.

Meliola aethiops Sacc. var ***moullavae*** Hosagoudar & Raghu in Hosagoudar, Raghu & Pillai, Nova Hedwigia 58: 533, 1994.
On *Moullava spicata* (Caesalpiniaceae), Gersoppa, Karnataka, Sept. 24, 1992, P.A. Raghu HCIO 40751 (type).

Meliola aequatoriensis Petrak, Sydowia 2: 339, 1948.
On *Viburnum punctatum* (Caprifoliaceae), M.K. Vayal, Kanyakumari, Tamil Nadu, Aug. 6, 1977, A.N. Henry HCIO 30386.

Meliola affinis Sydow var. ***indica*** Hosagoudar, Nova Hedwigia 47: 538, 1988.
On *Memecylon edule* (Melastomataceae), Dharmasthala, Karnataka, Aug. 24, 1987, S. Manian HCIO 39392 (type).

Meliola africana Hansf., Sydowia 10: 62, 1957.
On *Canthium angustifolium* (Rubiaceae), Gersoppa, Karnataka, Oct. 24, 1992, P.A. Raghu HCIO 40863.

Meliola aglaicola Hansf., Reinwardtia 3: 92, 1954.
On *Aglaia minitiflora* (Meliaceae), Pamba, Idukki, Kerala, Oct. 12, 1983, V.B. Hosagoudar HCIO 40492.

Meliola ailanthi Sharma, Mohan & Florence emend Hosagoudar (*in ed*).
On *Ailanthus triphysa* (Simaroubaceae), Vettiyar, Kerala, Sept. 14, 1992, C.M. Pillai HCIO 40752.

Meliola albiziae Hansf. & Deight., Mycol. Pap. 23: 26, 1948.
On *Albizia gummifera* (Mimosaceae), Nyansiso, Gold Coast Colony, May 19, 1949, S.J. Hughes HCIO 23044; *A. zygia*,

Entebbe Road, Uganda, Africa, Aug. 1944, C.G. Hansford HCIO 10535.

Meliola albiziae Hansf. & Deight. var. ***odoratissimae*** Kapoor, Indian Phytopathol. 20: 151, 1967.
On *Albizia odoratissima* (Mimosaceae), Cherideshpur Bat Tea Estate, Dec. 15, 1959, J.L. Lampitt HCIO 27275 (type).

Mwliola albiziae Hansf. & Deight. var ***zygiae*** Hansf. & Deight., Mycol. Pap. 23: 26, 1948.
On *Albizia zygia* (Mimosaceae), British Mandated Togoland, May 27, 1949, S.J. Hughes HCIO 23042.

Meliola aliena Sydow, Leafl. Philipp. Bot. 5: 1535, 1912.
On Unknown host, Angat, Prov. of Bulacan, Luzon, Sept. 1913, M. Ramos HCIO 3182.

Meliola allophylli Doidge, Bothalia 2: 443, 1928.
On *Allophylus cobbe* (Sapindaceae), Radhanagari, Maharashtra, Oct. 1970, A.N. Thite HCIO 31626.

Meliola allophyli-concanici Hosagoudar (*in ed.*).
On *Allophylus concanicus* var. *lanceolatus* (Sapindaceae), Seithur hills, Oct. 9, 1992, V.B. Hosagoudar HCIO 40753 (type).

Meliola alongii Sydow, Ann. Mycol. 14: 355, 1916.
On *Alongium begoniifolium* (Alongiaceae), Los Banos, P.I., Jan. 1916, C.F. Baker HCIO 3183.

Meliola alstoniae Koord, Verhandl. K. Akad. Wetensch. Amsterdam 13: 170, 1907.
On *Alstonia scholaris* (Apocynaceae), Luzon, Nov.-Dec. 1910, E. Fenis HCIO 3184; Castlerock, Karnataka, Nov. 1969, A.N. Thite HCIO 31625; Idukki, Kerala, Dec. 15, 1982, V.B. Hosagoudar HCIO 40493; Valparai, Coimbatore, Tamil Nadu, Dec. 28, 1990, V.B. Hosagoudar HCIo 30527.

Meliola altissimae Hosagoudar in Hosagoudar & Goos, Mycotaxon 42: 129, 1991.
On *Vitex altissima* (Verbenaceae), Valparai, Coimbatore, Tamil Nadu, Dec. 26, 1990, V.B. Hosagoudar HCIO 30528 (type); Gersoppa, Karnataka, Sept. 24, 1992, P.A. Raghu HCIO 40754.

Meliola amphitricha Fries, Syst. Mycol. 2: 513, 1823.
On *Sapindus saponari* (Sapindaceae), Calauan, Prov. of Laguna, Luzon, Nov.-Dec. 1910, R.C. McGregor HCIO 3188.
Note: Hansford (1961) stated that no type specimen or type host can be assigned to this species and hence the species epithet is discarded. Toro (1952) has discussed in detail. However, the identity of this collection will be confirmed later.

Meliola anacardii Zimm., Centralbl. f. Bakt. Abt. 2, 8: 151, 1902.
On *Anacardium occidentale* (Anacardiaceae), Province of Rizal, Luzon, Aug. 1913, M. Ramos HCIO 3190; Vettiyar, Kerala, Sept. 24, 1992, C.M. Pillai HCIO 40755.

Meliola anceps Sydow, Ann. Mycol. 14: 76, 1916.
Meliola mussaendae Sydow, Ann. Mycol. 15: 190, 1917.
On *Mussaenda laxa* (Rubiaceae), Idukki, Kerala, Dec. 23, 1983, V.B. Hosagoudar HCIO 40494; Los Banos, P.I., Feb. 1914, C.F. Baker HCIO 3185; *Mussanda* sp., Philippica, Prov. of Lagura, Luzon, Nov. 1915, M. Ramos HCIO 3333.

Meliola ancistrocladi Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 218, 1990.
On *Ancistrocladus heyneanus* (Ancistrocladaceae), Idukki, Kerala, Oct. 2, 1983, V.B. Hosagoudar HCIO 40495 (type).

Meliola angiopteridis Hansf. var. ***indica*** Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 219, 1990.
On *Angiopteris evecta* (Angiopteridaceae), Idukki, Kerala, Feb. 20, 1984, B. Rajeevan HCIO 40498 (type).

Meliola anisophylleae Hansf. var. ***caralliae*** Hosagoudar, Siddappa & Udaiyan, Nova Hedwigia 56: 195, 1993.
On *Carallia brachiata* (Rhizophoraceae), Amboli, Maharashtra, Feb. 8, 1975, M.S. Patil HCIO 31945 (type).

Meliola aphanamixidis Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 404, 1990.
On *Aphanamixis polystachya* (Meliaceae), Nilgiris, Tamil Nadu, Nov. 23, 1972, E. Vajravelu HCIO 39435 (type).

Meliola arachnoidea Speg., Biol. Acad. Client. Corboda 11: 381, 1989.
On *Triumfetta bartramia* (Tiliaceae), Prov. of Bataan, Luzon, Dec. 1915, M. Ramos HCIO 3192.
Note: Hansford (1961) made this species synonymous to *Asteridiella arachnoidea* (Speg.) Hansf. reported on Bignoniaceae member. The identity of this taxon is to be confirmed.

Meliola arborescens Lev., Ann. Mycol. 11: 256,1913.
On *Eugenia jambolana* (Myrtaceae); Collection locality, date and collector unknown, HCIO 29106; *Eugenia* sp., Burma, Jan. 9, 1909, E.J. Butler HCIO 1037.
Note: Sydow & Sydow (1913) described *Meliola arborescens* and later transferred it to *Meliolina arborescens* (Sydow) Sydow.

Meliola artocarpi Yates, Philippine J. Sci. 12: 362, 1917.
On *Artocarpus* sp. (Moraceae), Catubig River, Samar, Feb.-March 1916, M. Ramos HCIO 3193; *A. heterophyllus* (Moraceae), Valparai, Coimbatore, Tamil Nadu, Dec. 25, 1990, V.B. Hosagoudar HCIO 30530; Vittal, Dakshina Kannada, Karnataka, Nov. 25, 1992, P.A. Raghu HCIO 40864.

Meliola artocarpi Yates var. ***indica*** Hosagoudar, Pillai & Raghu (*in ed.*)
On *Artocarpus gomezianus* ssp. *zeylanicus* (Moraceae), Gersoppa, Karnataka, May 29, 1992, P.A. Raghu HCIO 30989 (type).

Meliola arundinis Pat., J. de Bot. p. 348, 1897.
On *Phragmites australis* (Poaceae), Prov. of Laguna, June-

Aug. 1919, R.C. Luegregor HCIO 3194; *P. mauritianus*, Entebbe, Uganda, Africa, Aug. 1944, C.G. Hansford HCIO 10020; *P. karka*, Puttimari, Assam, M. Jualim HCIO 1991: Swarnapaur, Sibsagar, April 19, 1958, S. Chowdhury HCIO 26091.

Meliola asclepiadacearum Hansf., Proc. Linn. Soc. London 157: 22, 1945.
On Asclepiadaceae member, Radhanagari, Kolhapur, Maharashtra, Nov. 1980, A.N. Thite HCIO 33670.

Meliola atalantiae Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 220, 1990.
On *Atalantia wightii* (Rutaceae), Idukki, Kerala, Feb. 19, 1983, V.B. Hosagoudar HCIO 40496 (type).

Meliola atylosiae Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 220, 1990.
On *Atylosia lineata* (Fabaceae), Idukki, Kerala, Dec. 23, 1983, V.B. Hosagoudar·HCIO 40497 (type).

Meliola balakrishnanii Nair & Kaul, Sydowia 36: 206, 1983.
On *Capparis pedunculosa* (Capparaceae), Mahabaleshwar, Jan, 1977, V.p. Kaul HCIO 3384 (type).

Meliola bakeri Sydow, Ann. Mycol. 14: 355, 1916.
On *Tetrastigma* sp. (Leeaceae), Nov. 1915, M. Ramos HCIO 3197, 31988, 3199; *Leea* sp. (Leeaceae), Kudumatige, Karnataka, April 28, 1945, M.J. Thirumalachar HCIO 10899.

Meliola banahaoensis Yates, Philippine J. Sci. 13: 364, 1918.
On *Dysoxylum* ? (Meliaceae), M.T. Banajaq, Province of Laguna, Luzon, May 1917, M. Ocampi HCIO 3200.

Meliola bangalorensis Hansf. & Thirum., Farlowia 3: 290, 1948.
On *Ficus* sp. (Moraceae), Bannerghatta, Karnataka, Aug. 14, 1945, M.J. Thirumalachar HCIO 10867 (type).

Meliola banosensis Sydow var. ***puerariae*** Hosagoudar in Hosagoudar & Goos, Mycotaxon 42: 130, 1991.
On *Puareria* sp.(Fabaceae), Anamalai, Coimbatore, Dec. 20, 1990, V.B. Hosagoudar.HCIO 30531 (type).

Meliola bantamensis Hansf. var. ***keralensis*** Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 221, 1990.
On *Desmodium gyrans* (Fabaceae), Idukki, Kerala, Dec. 12, 1982, V.B. Hosagoudar HCIO 40499 (type).

Meliola bataanensis Sydow, Ann. Mycol. 12: 551, 1914.
On *Milletia* sp. (Fabaceae), Province of Tayabas, Luzon, Oct. 1910, M. Ramos HCIO 3204; Province of Bataan, Luzon, July 1913, E.D. Merrill HCIO 3205; *M. rubiginosa*, Idukki, Kerala, April 18, 1982, V.B. Hosagoudar HCIO 40500.

Meliola bauhiniae Yates, Philippine J. Bot. 13: 235, 1918.
On *Bauhinia* sp. (Fabaceae), Burgos, Prov. of Ilocos Norte, Luzon, Feb.-March 1917, M. Ramos HCIO 3206.

Meliola bauhiniicola Yamam., Trans. Nat. Hist. Soc. Formosa 31: 225, 1941.

On *Bauhinia racemosa* (Caesalpiniaceae), Geddapalli, East Godavari, Andhra Pradesh, Feb. 22, 1987, D. Narasimhan HCIO 39306; Gersoppa, Karnataka, Sept. 24, 1992, P.A. Raghu HCIO 40756.

Meliola beilschmediae Yamam., Trans. Nat. Hist. Soc. Formosa 31: 52, 1941.

On *Cinnamomum zeylanicum* (Lauraceae), Sun's Park, Conoor, Tamil Nadu, Jan. 1978, L.N. Nair HCIO 33805.

Meliola beilschmediae Yamam. var. ***cinnamomicola*** Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 222, 1990.

On *Cinnamomum malabatrum* (Lauraceae), Idukki, Kerala, Oct. 5, 1983, V.B. Hosagoudar HCIO 34973 (type).

Meliola bersamicola Hansf., J. Linn. Soc. London 51: 270, 1937.

On *Trichilia buchanani* (Meliaceae), Entebbe, Africa, Aug. 1944, C.G. Hansford HCIO 10554.

Meliola bhesae Hosagoudar in Hosagoudar & Goos, Mycotaxon 42: 131, 1991.

On *Bhesa indica* (Euphorbiaceae), Valparai, Coimbatore, Dec. 26, 1990, V.B. Hosagoudar HCIO 30535 (type).

Meliola bicornis Wint., Hedwigia 25: 99, 1886.

Meliola desmodii Karst. & Roum., Rev. Mycol. 12: 77, 1800.

M. gliricidiae Sydow, Ann. Mycol. 12: 550, 1914.

On *Desmodium* sp. (Fabaceae), Luzon, Jan. 1917, H.S. Yates HCIO 3261,3262; Burma, Nov. 30, 1912, E.J. Butler HCIO 3207; *D. triquetrum*, Anmode, Oct. 1974, A.N. Thite HCIO 3106; *D. velutinum,* Valparai, Coimbatore, Tamil Nadu, Dec. 26, 1990, V.B. Hosagoudar HCIO 30532; *D. telifolia,* Valparai, Coimbatore, Tamil Nadu, Dec. 26, 1990, V.B. Hosagoudar HCIO 30533; *D. triangulare* , Valparai, Coimbatore, Tamil Nadu, Dec. 26, 1990, V.B. Hosagoudar HCIO 30534; *Dolichos trilobus trilobus,* Pudukadu, Valparai, Coimbatore, Tamil Nadu, Jan. 17, 1987, V.B. Hosagoudar HCIO 39307; *Acacia sinuata* (Mimosaceae), Sampaje, Kodagu, Dec. 22,1991, B.R. Dayal HCIO 30832; *Gliricidia sepium* (Fabaceae), Luzon, Aug. 1913, M. Ramos 3273.

Meliola blepharidis Thite & Patil, Geophytology 15: 83, 1985.

On *Blaparis asperrimae* (Acanthaceae), Anmode, Maharashtra, Oct. 27, 1976, A.N. Thite HCIO 36360 (type).

Meliola boerlagiodendri Yates, Philippine J. Sci. 13: 365, 1918.

On *Boerlagiodendron* sp., MT. Binuang, Province of Tayabas, Luzon, May 1917, M. Ramos & G. Ejano HCIO 3208; *Brassaiopsis* sp. (Araliaceae), Amboli, Maharashtra, Sept. 28, 1976, M.S. Patil HCIO 32524.

Meliola brachiata Patil (*in ed.*).

On *Ixora brachiata* (Rubiaceae), Amboli, Maharashtra, March 1992, C.R. Patil HCIO 40729 (type, p.p.).

Meliola brideliae Stev. & Rold., Philippine J.Sci. 56: 69, 1935.

On *Bridelia tomentosa* (Euphorbiaceae), Radhanagari, Maharashtra, Dec. 1970, A.N. Thite HCIO 31627.

Meliola buchananiicola Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 23, 1990.

On *Buchanania lanzan* (Anacardiaceae), Idukki, Kerala, Dec, 14, 1982, V.B. Hosagoudar HCIO 40501 (type).

Meliola buchenaviae Bat. var. ***terminaliae*** Nair & Kaul, Sydowia 36: 206, 1983.

On *Terminalia tomentosa* (Combretaceae), Mahabaleshwar, Maharashtra, Jan. 1978, V.P. Kaul HCIO 33806 (type).

Meliola buteae Hafiz, Azmatulla & Kafi, Biologia 1: 112, 1955.

On *Butea monosperma* (Fabaceae),Radhanagari, Maharashtra, Nov. 10, 1974, M.S. Patil HCIO 31940; Idukki, Kerala, Oct. 9, 1982, V.B. Hosagoudar HCIO 40502.

Meliola butleri Sydow, Ann. Mycol. 9: 379, 1911.

On *Citrus grandis* (Rutaceae), Serdang, Selangor, Malaya, Nov. 5, 1952, A. Johnson HCIO 23098; *C. medica* var. *acida*, Aug. 15, 1906, S. Sere HCIO 1042; *C. deccanensis*, Burma, Jan. 9, 1908, E.J. Butler HCIO 1043; *C. aurantium* , Sikkim, April 4, 1957, J.N. Kapoor HCIO 25444; Tarhu, West Sikkim, April 5, 1962, J.N. Kapoor HCIO 28366; *Citrus* sp., Dhalghat, Cittagong, Bangladesh, Aug. 28, 1911, R. Sen HCIO 3209; Calcutta, West Bengal, July 28, 1919, S.N. Bal HCIO 3210; Bhouldari, Port Blair, Andaman, Feb. 8, 1917, M. Mitra HCIO 3211.

Meliola cadigensis Yates, Philippine J. Sci. 12: 363, 1917.

On *Glycosmis cochinchinensis* (Rutaceae), Mt. Cadig, Prov. of Tayabas, Luzon, Dec. 1916, H.S. Yates HCIO 3214; *Evodia roxburghiana* (Rutaceae), Castlerock, Karnataka, HCIO 40009.

Meliola cadigensis Yates var. ***glycosmidis*** (Kapoor) Hosagoudar, Crypt. Bot. 2/3: 186, 1991.

On *Glycosmis mauritiana* (Rutaceae), Calcutta, West Bengal, Aug. 9, 1919, S.N. Bal HCIO 1932(type); *G. macrocarpa*, Idukki, Kerala, Feb. 19, 1986, V.B. Hosagoudar HCIO 30361.

Meliola callicarpae Sydow, Ann. Mycol. 10: 80, 1912.

On *Callicarpa* sp. (Verbenaceae), Burgos, Prov. of Ilocos Norte, Luzon, Feb.-March 1917, M. Ramos HCIO 3216; *C. cana*, Bataan, Luzon, Dec. 1915, M. Ramos HCIO 3217; *C. lanata* , Anmode, Maharashtra, Nov. 1969, A.N. Thite HCIO 31628.

Meliola canarii Sydow, Ann. Mycol. 12: 550, 1914.

On *Canarium* sp. (Burseraceae), Luzon, Dec. 1915, M. Ramos HCIO 3230; *C. villosum*,. Luzon, Nov. 1915, M. Ramos HCIO 3232; *C. commune*, Amboina, July-Nov. 1913, C.R. Robinson HCIO 3231; *C. strictum* , Sampaje, Kodagu, Karnataka, Dec. 22, 1991, B.R. Dayal HCIO 30838.

Meliola cansjerae Hansf. & Thirum., Farlowia 3: 290, 1948.

On *Cansjera rheedi* (Opiliaceae), Nandi hills, Karnataka, March 23, 1945, M.J. Thirumalachar HCIO 10871 (type); Petlond, Sangli, Maharashtra, Dec. 17, 1983, C.R. Patil HCIO 40010.

Meliola cansjerae Hansf. & Thirum. var. ***indica*** Hosagoudar, Siddappa & Udaiyan, Nova Hedwigia 56: 196, 1993.

On *Cansjera rheedii* (Opiliaceae), Jammunarai, Nilgiris, Tamil Nadu, Feb. 18, 1991, V.B. Hosagoudar HCIO 30618 (type).

Meliola cansjericola Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 224, 1990.

On *Cansjera rheedii* (Opiliaceae), Idukki, Kerala, Jan. 8, 1982, V.B. Hosagoudar HCIO 40503 (type).

Meliola canthi Hansf., Proc. Linn. Soc. London 157: 22, 1945.

Meliola asterinoides Wint. var. *major* Gaill., Le Genre *Meliola* p. 58, 1892.

On *Plectranthus (Canthium) parviflora* (Rubiaceae), Bhubaneshwar, Orissa, Oct. 1020, S.N. Bal HCIO 3195; *Canthium rheedi*, South Kanara, Karnataka, April 27, 1913, T.R. Ranganath HCIO 10397.

Meliola capensis (Kalch. & Cooke) Theiss., Ann. Mycol. 10: 19, 1912.

On *Phialodiscus unijugata* (Sapindaceae), Manga, Sierra Leone, Feb. 17, 1938, F.C. Deighton HCIO 3233.

Meliola capensis (Kalch. & Cooke) Theiss. var. ***blightiae*** Hansf. & Deight., Mycol. Pap. 23: 45, 1948.

On *Blightia sapida* (Sapindaceae), Gold Coast, June 9, 1949, S.J. Hughes HCIO 2304.

Meliola capensis (Kalch. & Cooke) Theiss. var ***emerginati*** Hosagoudar, Pillai & Raghu (*in ed.*).

On *Sapindus emerginatus* (Sapindaceae), Gersoppa, May 16, 1992, C.M. Pillai HCIO 30990 (type).

Meliola capensis (Kalch. & Cooke) Theiss. var. ***lecaniodisci*** Hansf. & Deight., Mycol. Pap. 23: 46, 1948.

On *Lecaniodiscus cupanioides* (Sapindaceae), Gold Coast, May 24, 1949, S.J. Hughes HCIO 23039.

Meliola capensis (Kalch. & Cooke) Theiss. var ***malayensis*** Hansf., Sydowia 10: 67, 1957.

On *Nephelium longan* (Sapindaceae), Idukki, Kerala, April 4, 1982, V.B. Hosagoudar HCIO 40504; *Nephelium* sp., Agumbe, Karnataka, May 6, 1992, C.M. Pillai HCIO 30991.

Meliola capensis (Kalch. & Cooke) Theiss. var ***pancoviae*** Hughes, Mycol. Pap. 50: 83, 1953.

On *Pancovia brijuga* (Sapindaceae), Pokoasi, Gold Coast Colony, May 25, 1949, S.J. Hughes HCIO 23038.

Meliola capensis (Kalch. & Cooke) Theiss. var. ***schleicherae*** Hosagoudar & Pillai in Hosagoudar, Raghu & Pillai, Nova Hedwigia 58: 537, 1994.

On *Schleichera oleosa* (Sapindaceae), Vettiyar, Kerala, Sept. 14, 1992, C.M. Pillai HCIO 40757 (type); Anamalai, Coimbatore, Tamil Nadu, Dec. 26, 1990, V.B. Hosagoudar HCIO 30536(as *M. capensis* var. *malayensis*)

Meliola capitata Thite (*in ed.*).

On *Gnetum ula* (Gnetaceae), Londha, Karnataka, Nov. 1969, A.N. Thite HCIO 31623 (type).

Meliola capnodioides Theum., Flora 59: 569, 1876.
Meliola cavitensis Yates, Philippine J. Sci. 13: 366, 1916.
On *Coleus* sp. (Verbenaceae), Talisay Ridge, Province of Vavite, Luzon, Jan. 20-21, 1917, E.D. Merrill HCIO 3236.

Meliola capparidis Hansf., Proc. Linn. Soc. London 157: 184, 1945.
On *Capparis afzelli* (Capparaceae), Entebbe, Africa, May 1944, C.G. Hansford HCIO 10426; *C. divaricata*, Amboli, Maharashtra, Jan. 4, 1984, A.B. Pawar HCIO 36389.

Meliola cardiospermi Hansf. & Stev., J. Linn. Soc. London 51: 271, 1937.
On *Cardiospermum* sp. (Sapindaceae), Entebbe road, Uganda, March, C.G. Hansford HCIO 3234.

Meliola carissae Doidge, Bothalia 1: 72, 1921.
On *Carissa* sp.(Apocynaceae), Nalur, Thirthahalli, Karnataka, April 4, 1945, M.J. Thirumalachar HCIO 10901.

Meliola carissae Doidge var. ***indica*** Hansf., Sydowia 10: 67, 1957.
On *Carissa carandas* (Apocynaceae), Idukki, Kerala, Oct. 8, 1983, V.B. Hosagoudar HCIO 39393.

Meliola carpolobiicola Hansf.& Deight., Mycol Pap. 23: 4, 1948.
On *Carpolobia lutea* (Polygalaceae), Gold coast, May 24, 1949, S.J. Hughes HCIO 23031.

Meliola celticola Yates, Philippine J. Sci. 13: 366, 1918.
On *Celtis philippensis* (Ulmaceae), Banghi Prov. of Ilocos Norte, Luzon, Feb.-March 1917, M. Ramos HCIO 3237.

Meliola celtidis Yates, Philippine J. Sci. 13: 367, 1918.
On *Celtis* sp. (Ulmaceae), Catubig river, Samar, Feb.-March 1916, M. Ramos HCIO 3238.

Meliola ceropegiae Hosagoudar & Ramachandran in Hosagoudar & Goos, Mycotaxon 42: 132, 1991.
On *Ceropegia* sp. (Asclepiadaceae), Agumbe, Karnataka, Oct. 2, 1990, V.S. Ramachandran HCIO 30537 (type).

Meliola chandleri Hansf., J. Linn. Soc. London 51: 271, 1937.
In *Excoecaria crenulata* (Euphorbiaceae), Idukki, Kerala, Dec. 29, 1983, V.B. Hosagoudar HCIO 40505.

Meliola chandleri Hansf. var. ***excoecariae*** Hosagoudar, Lakshmanan & Viswanathan, Indian J. Bot. 11: 185, 1988.
On *Excoecaria crenulata* (Euphorbiaceae), Senjirayan Koilmalai, Singarpeth, North Arcot, Tamil Nadu, M.B. Viswanathan AMH 7133 (type).

Meliola chandolensis Patil (*in ed.*).
On *Ixora parviflora* (Rubiaceae), Nivale, Sangli, Maharashtra, Jan. 22, 1992, C.R. Patil HCIO 40730 (type).

Meliola chandrasekharanii Hosagoudar in Hosagoudar & Goos, Mycotaxon 42: 133, 1991.

On *Apodytes beddomei* (Icacinaceae), Idukki, Kerala, Dec. 15, 1982, V.B. Hosagoudar HCIO 40506 (type); *A. nimmoniana*, Anamalai, Coimbatore, Dec. 27, 1990, V.B. Hosagoudar HCIO 30538.

Meliola citricola Sydow, Ann. Mycol. 15: 183, 1917.

On *Citrus aurantium* (Rutaceae), Anamalai, Coimbatore, Dec. 27, 1990, V.B. Hosagoudar HCIO 30539; Idukki, Kerala, Dec. 14, 1992, V.B. Hosagoudar HCIO 40567; *Citrus* sp., San Antonio Prov. of Laguna, Luzon, Oct. 1915, M. Ramos HCIO 3241,3242.

Meliola clausenae Hosagoudar in Hosagoudar & Goos, Mycotaxon 42: 133, 1991.

On *Clausena indica* (Rutaceae), Idukki, Kerala, Feb. 23, 1983, V.B. Hosagoudar HCIO 40508 (type); Topslip, Anamalai, Coimbatore, Tamil Nadu, Dec. 20, 1990, V.B. Hosagoudar HCIO 30540.

Meliola clerodendricola Henn., Hedwigia 37: 288, 1895.

Meliola sakawensis Henn., Hedwigia 43: 141, 1904.

On *Clerodendron manahassae* (Verbenaceae), Manila and vicinity, Luzon, Feb. 22, 1916, H.S. Yates HCIO 3372; Mt. Marivasles, Luzon, April 1912, P.W. Grapp HCIO 3373; Prov. of Rizal, Luzon, Nov. 1915, M. Ramos HCIO 3374; *Lantana* sp.(Verbenaceae), Aburg, Gold coast, May 24, 1949, S.J. Hughes HCIO 23097; *Vitex leucoxylon* (Verbenaceae), North Kanara, Karnataka, Oct. 1919, J.L. Sedgwick HCIO 1984. *Lantana? camara* (Verbenaceae), Aburi, Gold coast colony, May 24, 1949, S.J. Hughes HCIO 23097; *Clerodendrum viscosum* (Verbenaceae), Idukki, Kerala, Dec. 21, 1983, V.B. Hosagoudar HCIO 40510; Nilgiris, Tamil Nadu, Jan. 24, 1990, V.B. Hosagoudar HCIO 30362; Gersoppa, Karnataka, Dec. 3, 1992, J. Bhandary HCIO 40865; *Clerodendrum* sp., Uganda, May 1937, HCIO 3248.

Meliola clerodendricola Henn. var. ***micromera*** (Sydow) Hansf., Sydowia Beih. 2: 694, 1961.

On *Gmelina arborea* (Verbenaceae), Idukki, Kerala, Dec. 12, 1982, V.B. Hosagoudar HCIO 40511.

Meliola clitoriae Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 227, 1990.

On *Clitoria ternatea* (Fabaceae), Idukki, Kerala, Dec. 15, 1983, V.B. Hosagoudar HCIO 40512 (type).

Meliola coreopsidis Thite & Kulkarni, J. Shivaji Univ. (Sci.) 18: 209, 1978.

On *Coereopsis curistosa* (Asteraceae), Anmode, Maharashtra, Nov. 1969, A.N. Thite HCIO 31622 (type).

Meliola coilicosa Nair & Kaul, Sydowia 36: 204, 1983.

On *Canthium dicoccum* (Rubiaceae), Mahabaleshwar, Jan. 1978, V.P. Kaul HCIO 33807 (type); Idukki, Kerala, Feb. 18, 1983, V.B. Hosagoudar HCIO 40513; *C. rheedii*, Mahabaleshwar, Maharashtra, Jan. 17, 1985, C.R. Patil HCIO 40007.

Meliola commixta Sydow, Leafl. Philippine Bot. 9: 3117, 1925.
On *Nephelium longan* (Sapindaceae), Idukki, Kerala, Oct. 9, 1982, V.B, Hosagoudar HCIO 40514.

Meliola connari Sydow, Philippine J. Sci. 12: 364, 1917.
On *Connarus* sp. (Connaraceae), Basiad Prov. of Tayabas, Luzon, Dec. 1916, H.S. Yates HCIO 3248.

Meliola connari Yates var. **indica** Hosagoudar in Hosagoudar & Goos, Mycotaxon 42: 133, 1991.
On *Connarus sclerocarpus* (Connaraceae), Anamalai, Coimbatore, Dec. 27, 1990, V.B. Hosagoudar HCIO 30541 (type).

Meliola connaricola Hànsf., Sydowia 9: 40, 1955.
On *Connarus monocarpus* (Connaraceae), Radhanagari, Kolhapur, Jan. 21, 1975, M.S. Patil HCIO 31941.

Meliola crescentiae Stev. , Ann. Mycol. 240, 1928.
On *Heterophragma roxburghi* (Bignoniaceae), Dharwar, Karnataka, Dec. 1912, L.J. Sedgwick HCIO 1993.

Meliola cryptocariicola Hosagoudar & Raghu, New Botanist 20: 67, 1993.
On *Cryptocarya bourdillonii* (Lauraceae), Gersoppa, Uttara Kannada, Karnataka, Oct. 21, 1992, P.A. Raghu HCIO 40886 (type).

Meliola culebrensis Hansf., Sydowia Beih. 1: 106, 1957.
On *Strobilanthus reticulatus* (Acanthaceae), Amboli, Maharashtra, Dec. 3, 1976, M.S. Patil HCIO 36745.

Meliola cycleae Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 228, 1990.
On *Cyclea peltata* (Menispermaceae), Idukki, Kerala, Dec. 12, 1982, V.B. Hosagoudar HCIO 40516 (type).

Meliola cymbopogonis Kapoor, Indian Phytopathol. 20: 152, 1967.
On *Cymbopogon nardus* (Poaceae), Wynaad, Malabar, Kerala, Nov. 13, 1909, W. McRae HCIO 28213 (type); *C. flexuosus*, Idukki, Kerala, March 26, 1983, V.B. Hosagoudar HCIO 40517.

Meliola daviesii Hansf., Proc. Linn. Soc. London 157: 176, 1946.
On *Jasminum* sp. (Oleaceae), Burma, Nov. 24, 1912, E.J. Butler HCIO 1948; Palampur, May 16, 1963, V.S. Sharma HCIO 27855 (Associated with rust).

Meliola deinbolliae Hansf., J. Linn. Soc. London 51: 273, 1937.
On *Deinbollia pinnata* (Sapindaceae), Mabang, Sierra Leone, April 30, 1936, F.C. Deighton HCIO 3254. *D. furus-tomentosa*, Entebbe road, Uganda, Africa, Aug. 1944, C.G. Hansford HCIO 10534; *D. pinnata*, Oblongo, Gold Coast Colony, April 24, 1949, S.J. Hughes HCIO 23030.

Meliola densa Cooke, Grevillea 12: 85, 1884.
On *Syzygium munroni* (Myrtaceae), Idukki, Kerala, Feb. 18, 1983, V.B. Hosagoudar HCIO 40518; *Eugenia* sp. (Myrtaceae),

Hosmatta, Karnataka, Aug. 31, 1992, H.S.P. Shenoy HCIO 40866.

Meliola dichapetali Hansf. & Thirum., Farlowia 3: 292, 1948.
On *Dichapetalum gelonoides* (Dichapetalaceae), Balehonnur, Karnataka, April 29, 1945, M.J. Thirumalachar HCIO 10858 (type).

Meliola dichotoma Berk. & Curt., Proc. Amer. Acad. Arts & Sci. 4: 130, 1860.
On *Hedera helix* (Araliaceae), Narkanda, Simla Hills, Nov. 13, 1959, M.M. Payak HCIO 26879.

Meliola dimidiatae Hosagoudaar in Hosagoudar & Goos, Mycotaxon 37: 229, 1990.
On *Apodytes dimidiata* (Icacinaceae), Idukki, Kerala, Oct. 4, 1983, V.B. Hosagoudar 40519 (type).

Meliola diospyri Sydow, Ann. Mycol. 9: 381, 1911.
On *Diospyros diocorata* (Ebenaceae), Basiad, Luzon, Dec. 1916, H.S. Yates HCIO 3265; *D. mespiliformis*, Pokoasi, Gold Cost Colony, June 1, 1949, S.J. Hughes HCIO 23032; *D. montana*, Sidrabramma, Koppa, Karnataka, Sept. 15, 1903, E.J. Butler HCIO 1044; Anmode, Maharashtra, Oct. 17, 1974, A.N. Thite HCIO 31905; *D. microphylla*, Castlerock, Karnataka, Jan. 1o, 1984, C.R. Patil HCIO 40008; *D. sylvatica*, Idukki, Kerala, Oct. 5, 1983, V.B. Hosagoudar HCIO 40520; *D. malabarica*, Bekur, Kasargod, Kerala, Sept. 13, 1992, P. Rama Bhat HCIO 40758; *D. montana*, Anmode, Maharashtra, Oct. 17, 1974, A.N. Thite HCIO 31905.

Meliola diplichaeta Sydow, Leafl. Philippine J. Bot. 5: 1536, 1912.
On *Talauma villariana* (Magnoliaceae), Apayao Subprovince, Luzon, May 1917, E. Fenix HCIO 3264.

Meliola dracaenicola Pat. & Har., Bull. Soc. Mycol. France 24: 1908.
On *Dracaena* sp.(Agavaceae), Gold Coast, June 1, 1949, S.J. Hughes HCIO 23033.

Meliola drepanochaeta Sydow var. ***insignis*** Hosagoudar, J. Econ. Tax. Bot. 11: 157, 1987.
On *Litsea insignis* (Lauraceae), Anamalai, Coimbatore. Tamil Nadu, Jan. 17, 1987, V.B. Hosagoudar HCIO 39308(type).

Meliola drypeticola Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 230, 1990.
On *Drypetes macrophylla* (Euphorbiaceae), Idukki, Kerala, Feb. 18, 1983, V.B. Hosagoudar HCIO 40521 (type).

Meliola elaeis Stevens, Ann. Mycol. 26: 181, 1928.
On *Elaeis guineensis* (Arecaceae), Ampremdo, Gold Coast Colony, May 10, 1949, S.J. Hughes HCIO 32109.

Meliola elaeocarpae Yates, Philippine J. Sci. 12: 365, 1917.
On *Elaeocarpus* sp. (Elaeocarpaceae), Benguep subprovince, Luzon, March-May, 1916, H.S. Yates HCIO 3266.

Meliola entadicola Deight., Sydowia 11: 104, 1958.
On *Entada rheedi* (Mimosaceae), Gersoppa, Karnataka, Oct. 24, 1992, P.A. Raghu HCIO 40867.

Meliola entebbeensis Hansf., Proc. Linn. Soc. London 156: 65, 1944.
On *Aristolochia densivenia* (Aristolochiaceae), Entebbe road, Africa, May 1944, C.G. Hansford HCIO 10408.

Meliola erithalidis (Ciff.) Hansf., Proc. Linn. Soc. London 160: 130, 1948.
On *Canthium parviflora* (Rubiaceae), Petlond, Sangli, Maharashtra, Dec. 20, 1980, C.R. Patil HCIO 40018.

Meliola ervatamiae Hosagoudar, Sydowia 40: 115, 1987.
On *Ervatamia heyneana* (Apocynaceae), Anamalai, Coimbatore, Tamil Nadu, Jan. 17, 1987, V.B. Hosagoudar HCIO 39309(type).

Meliola eugeniae-jamboloidis Hansf., Reinwardtia 3: 98, 1954.
On *Sygygium munronii* (Myrtaceae), Anamalai, Coimbatore, Tamil Nadu, Jan. 17, 1987, V.B. Hosagoudar HCIO 39311.

Meliola erycibes-paniculatae Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 231, 1990.
On *Erycibe paniculata* (Convolvulaceae), Idukki, Kerala, Dec. 12, 1982, V.B. Hosagoudar HCIO 40522 (type); Gersoppa, Karnataka, May 24, 1992, P.A. Raghu HCIO 40759.

Meliola erythrinae Sydow, Ann. Mycol. 15: 185, 1917.
On *Erythrina variegata* (Fabaceae), Anamalai, Coimbatore, Tamil Nadu, Dec. 26, 1990, V.B. Hosagoudar HCIO 30545; *E. stricta*, Vettiyar, Kerala, Nov. 15, 1992, C.M. Pillai HCIO 40868.

Meliola erythropali Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 232, 1990.
On *Erythropalum populifolium* (Erythropalaceae), Idukki, Kerala, Dec. 13, 1982, V.B. Hosagoudar HCIO 40523 (type).

Meliola erythroxylifolii Batista & Vital, Ann. IV Congr. Soc. Bot. Brazil p. 105, 1953.
On *Etythroxylum obtusifolium* (Erythroxylaceae), Idukki, Kerala, Dec. 28, 1983, V.B. Hosagoudar HCIO 40524.

Meliola eugeniicola Stev., Mem. Dept. Agric. India 15: 107, 1928.
On *Eugenia eucalyptoides* (Myrtaceae), Panchanadi, Mangalore, Karnataka, April 16, 1913, L.S. Money HCIO 1989.

Meliola euonymi Stev. ex. Hansf., Sydowia Beih. 1: 108, 1957.
On *Euonymus indicus* (Celastraceae), Radhanagari, Kolhapur, Maharashtra, Feb. 10, 1978, M.S. Patil HCIO 32522.

Meliola evodiicola Hansf., Reinwardtia 3: 105, 1954.
On *Evodia roxburghiana* (Rutaceae), Amboli, Maharashtra, Sept. 28, 1976, M.S. Patil HCIO 32521.

Meliola exocarpiae Yates, Philippine J. Sci. 13: 368, 1918.
On *Exocarpus latifolium* (Santalaceae), Burgos, Prov. of Ilocos Norte, Luzon, Feb.-March, 1917, M. Ramos HCIO 3268.

Meliola fagarae Hansf., Proc. Linn. Soc. London 153: 10, 1941.
On Rutaceae member, Amremdo, Gold Coast Colony, May 10, 1949, S.J. Hughes HCIO 23108.

Meliola fagraeae Sydow, Ann. Mycol. 12: 549, 1914.
On *Fagraea plumeriaefolia* (Potaliaceae), Mt. Isarog Camarines, Nov.-Dec. 1913, M. Ramos HCIO 3270; *Fragraea* sp., Mt. Lumutan Province of Rizal, Luzon, July 1917, M. Ramos & G. Edano HCIO 3269.

Meliola ficicola Hansf. & Thirum., Farlowia 3: 293, 1948.
On *Ficus* sp. (Moraceae), Balehonnur, Karnataka, April 29, 1945, M.J. Thirumalachar HCIO 10868 (type, p.p.).

Meliola ficium Yates, Philippine J. Sci. 13: 368, 1918.
On *Ficus* sp. (Moraceae), Mt. Banajao, Prov. of Laguna, Luzon, May 1917, M. Ocampo HCIO 3271.

Meliola filicii Hosagoudar, Nova Hedwigia 52: 500, 1991.
On *Filicium dicipiens* (Sapindaceae), Idukki, Kerala, Feb. 8, 1981, N.C. Nair HCIO 30391 (type).

Meliola floridensis Hansf., Sydowia 10: 72, 1957.
On *Persea macrantha* (Lauraceae), Anamalai, Coimbatore, Tamil Nadu, Jan 17, 1987, V.B. Hosagoudar HCIO 39437.

Meliola floridensis Hansf. var. ***pudukadensis*** Hosagoudar, Sydowia 40: 117, 1987.
On *Persea macrantha* (Lauraceae), Anamalai, Coimbatore, Tamil Nadu, Jan. 17, 1987, V.B. Hosagoudar HCIO 39315(type).

Meliola furcata Lev., Ann. Sci. Nat. III. 5: 266, 1846.
On *Leea latifolia* (Leeaceae), Mahabaleshwar, Maharashtra, March 22, 1980, M.S. Patil HCIO 36746.

Meliola gamblei Hosagoudar in Hosagoudar & Goos, Mycotaxon 42: 134, 1991.
On *Smilax zeylanica* (Smilacaceae), Kimbar, Karnataka, Dec. 16, 1918, J.S. Gamble HCIO 30546 (type).

Meliola ganophilli Stev. & Rold., Philippine J. Sci. 56: 56, 1935.
Meliola benguiensis Yates, Philippine J. Sci. 56: 57, 1935.
On *Bengui* sp., Prov. of Ilojcos Norte, Luzon, Feb.-March 1917, M. Ramos HCIO 3201.
Note: Critical study is needed to assign this species correctly.

Meliola garciniae Yates, Philipp. J. Sci. 13: 369, 1918.
On *Garcinia spicata* (Clusiaceae), Gersoppa, May 29, 1992, P.A. Raghu HCIO 30992; *Garcinia* sp., Burgos, Prov. of Ilocos Norte, Luzon, Feb.-March, 1917, M. Ramos HCIO 3272.

Meliola gardneriae Hansf. & Thirum., Farlowia 3: 293, 1948.
On *Gardneria* sp. (Loganiaceae), Balehonnur, Karnataka, April, 29, 1945, M.J. Thirumalachar HCIO 10877 (type).

Meliola gardneriae Hansf. & Thirum. var. ***indica*** Hosagoudar *et al.*, Nova Hedwigia 56: 197, 1993.
On *Gardneria ovata* (Loganiaceae), Kolithorai, Nilgiris, Tamil Nadu, Feb. 16, 1991, V.B. Hosagoudar HCIO 30619 (type).

Meliola gemellipoda Doidge, Bothalia 1: 80, 1920.
Meliola busogensis Hansf., J. Linn. Soc. London 51: 80, 1920.
On *Jasminum pauciflorum* (Oleaceae), Entebbe, Africa, Aug. 1944, C.G. Hansford HCIO 10531.

Meliola geniculata Sydow & Butler, Ann. Mycol. 9: 381, 1911.
On *Odina wodier* (Anacardiaceae), Pulliyanur, Kerala, Oct. 8, 1907, E.J. Butler HCIO 1366 (type); *Lannea welwiitochii,* Entebbbe, Uganda, Africa, Aug. 1944, C.G. Hansford HCIO 10552.

Meliola gersoppaense Hosagoudar, Pillai & Raghu (*in ed.*)
On *Syzygium* sp (Myrtasceae), Gersoppa, Karnataka, May 29, 1992, P.A. Raghu HCIO 30993 (type).

Meliola glochidii Stev. & Rold. ex Hansf. var. ***velutini*** Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 233, 1990.
On *Glochidion velutinum* (Euphorbiaceae), Idukki, Kerala, Dec. 29, 1983, V.B. Hosagoudar HCIO 40526 (type).

Meliola glochidiicola Yamam., Trans. Nat. Hist. Soc. Formosa 31: 19, 1941.
On *Glochidion* sp.(Euphorbiaceae), Radhanagari, Maharashtra, Dec. 1974, A.N. Thite HCIO 31904; *Glochidion ellipticum*, Idukki, Kerala, April 11, 1982, V.B. Hosagoudar HCIO 40527.

Meliola glycosmidis Kapoor, Indian Phytopathol. 20: 153, 1967.
On *Glycosmis macrocarpa* (Rutaceae), Idukki, Kerala, Feb. 19, 1983, V.B. Hosagoudar HCIO 40528; *G. pantaphylla*, Topslip, Anamalai, Coimbatore, Tamil Nadu, Dec. 20, 1990, V.B. Hosagoudar HCIO 30548.

Meliola gneti Hansf., Reinwardtia 3: 85, 1954.
On *Gnetum ula* (Gnetaceae), Idukki, Kerala, Feb. 20, 1983, V.B. Hosagoudar HCIO 40529; Valparai, Coimbatore, Dec. 26, 1990, V.B. Hosagoudar HCIO 30547.

Meliola goosii Hosagoudar, Crypt. Bot. 2/3: 186, 1991.
On *Viburnum punctatum* (Caprifoliaceae), Benne forest, Nilgiris, Tamil Nadu, Jan. 24, 1990, V.B. Hosagoudar HCIO 30363 (type).

Meliola gouniae Hansf., Proc. Linn. Soc. London 157: 22, 1945.
On *Zyzyphus trinervia (Z. oenoplea)* (Rhamnaceae), Patgoan, Kolhapur, Maharashtra, Feb. 7, 1984, C.R. Patil HCIO 40016.

Meliola gregoriana Stev., Bull. Bishop Mus. 19: 39, 1925.
On *Dracaena tennuifolia* (Agavaceae), Amboli,

Sindhudurgh, Maharashtra, March 6, 1990, M.S. Patil HCIO 36747.

Meliola groteana Sydow, Ann. Mycol. 11: 402, 1913.
On *Embelia viridiflora* (Myrsinaceae), Radhanagari, Kolhapur, Maharashtra, Jan. 21, 1975, M.S. Patil HCIO 31942; *Maesa indica* (Myrsinaceae), Idukki, Kerala, April 19, 1982, V.B. Hosagoudar HCIO 40530; Anamalai, Coimbatore, Tamil Nadu, Dec. 25, 1990, V.B. Hosagoudar HCIO 30549; Nilgiris, Tamil Nadu, Jan. 25, 1990, V.B. Hosagoudar HCIO 30364; *M. lanceolata*, Entebbe, Africa, Oct. 1944, C.G. Hansford HCIO 10596.

Meliola groteana Sydow var. ***ardisiicola*** Hansf., Sydowia 9: 18, 1955.
On *Embelia ribens* (Myrsinaceae), Nechal, Near Koyna Dam, Satara, Maharashtra, Dec. 6, 1984, C.R. Patil HCIO 40015.

Meliola hamata Sydow, Ann. Mycol. 12: 548, 1914.
On *Buchanania arborescens* (Anacardiaceae), Rizal Province, Luzon, Jan. 1917, H.S. Yates HCIO 3278; *B. nitida*, San Antonio, Province of Laguna, Luzon, Oct. 1915, M. Ramos HCIO 3279; *B. arborea*, Basiam Province of Tayabas, Luzon, Dec. 1916, H.S. Yates HCIO 3276; Sept, 1913, M. Ramos HCIO 3277.

Meliola harrisoniae Hansf., J. Linn. Soc. London 51: 54, 1938.
On *Harrisonia abyssinica* (Asteraceae), Entebbe, Africa, Aug. 1944, C.G. Hansford HCIO 10530.

Meliola heritiericola Thite & Kulkarni, J. Shivaji Univ. (Sci.)18: 210, 1978.
On *Heritiera littoralis* (Sterculiaceae), Londha, Karnataka, Nov. 1969, A.N. Thite HCIO 31624 (type).

Meliola heterocephala Sydow, Ann. Mycol. 14: 356, 1916.
On *Desmodium pulchellum* (Fabaceae), Province of Laguna, Luzon, Nov. 1915, M. Ramos HCIO 3281; *D. laxiflorum*, Province of Rizal, Luzon, Dec. 1915, M. Ramos HCIO 3280.

Meliola heudelotii Gaill., Le Genre Meliola p. 49, 1892.
On *Memecylon edule* (Melastomataceae), Tummalabailu, Nallamalai, Kurnool, Andhra Pradesh, April 16, 1986, V.B. Hosagoudar HCIO

Meliola heyneae Hansf. & Thirum., Farlowia 3: 294, 1948.
On *Heynea trijuga* (Meliaceae), Kore kote, Thirthahalli, Karnataka, April 1945, M.J. Thirumalachar HCIO 10863 (type).

Meliola hibisci Fries
On *Hibiscus esculentus* (Malvaceae), La vega, Aug. 1925, R. Cifferi HCIO 3285.
Note: This is an excluded species (Hansford, 1961, Toro, 1952).

Meliola himalayensis Kapoor, Indian Phytopathol. 20: 154, 1967.
On *Bridelia* sp. (Euphorbiaceae), Sribadam, West Sikkim, April 7, 1962, J.N. Kapoor HCIO 28363 (type).

Meliola hippocrateicola Hansf. & Deight., Mycol. Pap. 23: 39, 1948.

On *Hippocratus obtusifolia,* Amboli, Maharashtra, Sept. 28, 1976, M.S. Patil HCIO 32562.

Meliola holigarnae Stev., Mem. Dept. Agric. India Bot. Ser.15: 108, 1928.

On *Holigarna grahami* (Anacardiceae), Ekambi, North Kanara, Karnataka, Oct. 1919, L.J. Sedgwick HCIO 1986A; Wynaad, Kerala, Nov. 12, 1909, W. McRae HCIO 10405; Idukki, Kerala, Dec. 17, 1982, V.B. Hosagoudar HCIO 40531; Anamalai, Coimbatore, Tamil Nadu, Dec. 26, 1990, V.B. Hosagoudar HCIO 30550; Kaiga forest, Karnataka, Dec. 6, 1991, S. Shetty HCIO 30831; *H. arnottiana*, Seithur hills, Kamarajar dist., Tamil Nadu, Oct. 12, 1992, V.B. Hosagoudar HCIO 40760.

Meliola hopeae Yates, Philippine J. Sci. 13: 369, 1918.

On *Hopea* sp. (Dipterocarpaceae), Mt. Cadig., Prov. of Tayabas, Luzon, Dec. 1916, H.S. Yates HCIO 3286.

Meliola hunteriae Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 234, 1990.

On *Hunteria corymbosa* var. *roxburghiana* (Apocynaceae), Idukki, Kerala, Dec. 28, 1983, V.B. Hosagoudar HCIO 40532 (type).

Meliola hyptidis Sydow, Ann. Mycol. 8: 36, 1910.

On *Hyptis suaveolaena* (Lamiaceae), Luzon, Dec. 1915, M. Ramos HCIO 3288; *Hyptis* sp., Luzon, Dec. 1915, M. Ramos HCIO 3287.

Meliola icnocarpicola Hansf., Sydowia Beih. 2: 559, 1961.

On *Icnocarpus frutescense* ((Apocynaceae), Herathata, Thirthahalli, Karnataka, April 3, 1945, M.J. Thirumalachar HCIO 10878 (type).

Meliola ilicis-malabaricae Hosagoudar & Raghu *(in ed.)*

On *Ilex malabarica* (Aquifoliaceae), Gersoppa, Uttara Kannada, Karnataka, Oct. 21, 1992, P.A. Raghu HCIO 40889 (type).

Meliola imperata Sydow, Ann. Mycol. 15: 186, 1917.

On *Imperata* sp. (Poaceae), San Antoniae, Luzon, Oct. 1915, M. Ramos HCIO 3289, 3290.

Meliola indica Sydow in Sydow & Butler, Ann. Mycol. 9: 382, 1911.

Meliola barringtoniae Yates, Philippine J. Sci. 12: 363, 1917.

On *Barringtonia acutangula* (Lecythidaceae), Dacca, Bangla Desh, March 20, 1910, A. Som HCIO 1036; *B. luzonensis*, Luzon, April-May, 1915, M. Ramos & D. Dersy HCIO 3203; *Barringtonia* sp., Luzon, July, 1917, M. Ramos & G. Edano HCIO 3202.

Meliola indica Sydow var.***careyae*** Stev., Ann. Mycol. 26: 223, 1928.

On *Careya arborea* (Lecythidaceae), Idukki, Kerala, Jan. 1982, V.B. Hosagoudar HCIO 40533; Kaiga, Uttara Kannada, Karnataka, March 19, 1992, S. Shetty HCIO 30837; Hosmatta, Karnataka, Aug. 31, 1992, H.S.P. Shenoy HCIO 40869; Uttara Kannada, Karnataka, March 19, 1992, S. Shetty HCIO 30837.

Meliola integrifolii Patil (*in ed.*)
On *Artocarpus integrifolia* (Moraceae), Dajipur reserve forest, Kolhapur, Maharashtra, May 15, 1991, C.R. Patil HCIO 30805 (type).

Meliola intricata Sydow, Philippine J. Bot. 8: 268, 1913.
On *Scirpus grossus* (Cyperaceae), Luzon, Oct. 1915, M. Ramos HCIO 3291.

Meliola ixorae Yates, Philippine J. Sci. 12: 365, 1917.
On *Ixora philippensis* (Rubiaceae), Luzon, Feb. 1917, H.S. Yates HCIO 3292; *I. polyantha*, Amboli, Maharashtra, Feb. 23, 1975, M.S. Patil HCIO 31943; *I. coccinea*, Novale, Sangli, Maharashtra, Jan. 22, 1992, C.R. Patil HCIO 40733.

Meliola ixorae-coccineae Hosagoudar & Pillai in Hosagoudar, Raghu & Pillai, Nova Hedwigia 58: 539, 1994.
On *Ixora coccinea* (Rubiaceae), Vettiyar, Kerala, Sept. 14, 1992, C.M. Pillai HCIO 40761 (type).

Meliola ixorae Yates var. ***macrospora*** Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 235, 1990.
On *Ixora elongata* (Rubiaceae), Idukki, Kerala, Feb. 18, 1983, V.B. Hosagoudar HCIO 40534 (type).

Meliola jasmini Hansf. & Stev., J. Linn. Soc. London 51: 273, 1937.
On *Jasminum dichotomum* (Oleaceae), Entebbe, Africa, May 1944, C.G. Hansford HCIO 10447; *Jasminum* sp., Tropical Botanic Garden, Trivandrum, Kerala, Nov. 20, 1992, A.G. Pandurangan HCIO 40887.

Meliola jasminicola Henn., Hedwigia 34: 11, 1895.
On *Jasminum auriculatum* (Oleaceae), Dacca, Feb. 15, 1940, P. Maheshwari HCIO 3294; *J. bignonacearum*, Bear Shola, Kodaikanal, Tamil Nadu, Nov. 30, 1989, K. Ravikumar HCIO 30366; *J. malabaricum* (Oleaceae), Sirsi, North Kanara, Karnataka, Sept. 16, 1992, G.S. Kulkarni HCIO 3298; *J. rottlerianum*, Idukki, Kerala, Dec. 13, 1982, V.B. Hosagoudar HCIO 40535; *J. sambac*, Luzon, Oct. 1919, H.S. Yates HCIO 3299; Jan.-Feb., 1911, E.D. Merril HCIO 3300; *Jasminum* sp., Burma, Nov. 24, 1910, E.J. Butler HCIO 3293.

Meliola jayachandranii Hosagoudar, Sydowia 40: 117, 1987.
On *Isonandra lanceolata* var. *anfractuosa* (Sapotaceae), Valparai, Coimbatore, Tamil Nadu, Jan. 17, 1987, V.B. Hosagoudar HCIO 39313(type); Seithur hills, Kamarajar Dist., Tamil Nadu, Nov. 1992, V.B. Hosagoudar HCIO 40870.

Meliola karnatakaense Hosagoudar, Pillai & Raghu (*in ed.*)
On *Glochidion* sp. (Euphorbiaceae), Agumbe, Karnataka, May 7, 1992, C.M. Pillai HCIO 30994 (type).

Meliola kaverippai Hosagoudar, Pillai & Raghu (*in ed.*)
On *Cinnamomum* sp. (Lauraceae), Agumbe, Karnataka May 7, 1992, C.M. Pillai HCIO 30995 (type).

Meliola khayae var. ***minor*** Hansf. & Deight., Mycol. Pap. 23: 43, 1948.
On *Khaya grandifolia* (Meliaceae), British Mandated Togoland, May 27, 1949, S.J. Hughes HCIO 23100.

Meliola kingiodendri Hosagoudar, Dayal & Goos, Mycotaxon 46: 205, 1993.
On *Kingiodendron pinnatum* (Caesalpiniaceae), Sampaje, Kodagu, Karnataka, Dec. 22, 1991, B.R. Dayal HCIO 30836 (type).

Meliola koynae Patil (*in ed.*)
On Acanthaceae member, Narchal Dam (Koyna), Satara, Maharashtra, Dec. 6, 1984, C.R. Patil HCIO 40001 (type).

Meliola landolphiicola Hansf., Proc. Linn. Soc. London 157: 23, 1945.
On *Landolphia amoena* (Acanthaceae), Gold Coast, June 2, 1949, S.J. Hughes HCIO 23106; *Oncinotis* sp., Entebbe, Africa, Aug., 1944, C.G. Hansford HCIO 10542.

Meliola laxa Gaill. var. ***indica*** Hosagoudar, Pillai & Raghu (*in ed.*)
On *Syzygium zeylanicum* (Myrtaceae), Vettiyar, Kerala, May 10, 1992, C.M. Pillai HCIO 30996 (type).

Meliola lepisanthea Sacc., Atti Acad. Ven.-Trent.-Istr. 10: 61, 1917.
On *Lepisanthes* sp. (Sapindaceae), Luzon, Nov. 1915, M. Ramos HCIO 3301.

Meliola leptochaeta Sydow., Ann. Mycol. 15: 187, 1917.
On *Vavaea* sp. (Meliaceae), Prov. of Rizal, Luzon, Sept. 1915, H.S. Yates HCIO 3202.

Meliola ligustri Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 236, 1990.
On *Ligustrum walkeri* (Oleaceae), Idukki, Kerala, June 12, 1983, V.B. Hosagoudar HCIO 40536 (type); *L. robustum*, Nilgiris, Tamil Nadu, Jan. 24, 1990, V.B. Hosagoudar HCIO 30364.

Meliola linderae Yamam., Trans. Nat. Hist. Soc. Formosa 31: 20, 1941.
On *Actinodaphne hookeri* (Lauraceae), Idukki, Kerala, Oct. 10, 1982, V.B. Hosagoudar HCIO 42532.

Meliola linocierae-malabaricae Hosagoudar, Nova Hedwigia 47: 540, 1988.
On *Linociera malabarica* (Oleaceae), Idukki, Kerala, Dec. 28, 1983, V.B. Hosagoudar HCIO 39394 (type); Valparai, Coimbatore, Tamil Nadu, Dec. 26, 1990, V.B. Hosagoudar HCIO 30551; Gersoppa, Uttara Kannada, Karnataka, May 17, 1992, C.M. Pillai HCIO 30997.

Meliola litseae Sydow, Ann. Mycol. 15: 187, 1917.
On *Litsea glutinosa* (Lauraceae), Manila, March 1916, H.S. Yates HCIO 3308; *Litsea* sp., Prov. of Bataan, Luzon, Dec. 1915, M. Ramos HCIO 3305, 3306, 3307.

Meliola litseae Sydow var. ***floribundae*** Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 237, 1990.
On *Litsea floribunda* (Lauraceae), Idukki, Kerala, June 12, 1983, V.B. Hosagoudar HCIO 40538 (type).

Meliola litseae Sydow var. ***insignis*** Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 237, 1990.
On *Litsea insignis* (Lauraceae), Idukki, Kerala, June 10, 1983, V.B. Hosagoudar HCIO 40539 (type).

Meliola litseae Sydow var. ***keralensis*** Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 238, 1990.
On *Litsea stocksii* var. *glabrescens* (Lauraceae), Idukki, Kerala, Oct. 3, 1983, V.B. Hosagoudar HCIO 40540 (type).

Meliola litseae Sydow var. ***rotundipoda*** Hansf., Reinwardtia 3: 88, 1954.
On *Litsea coriacea* (Lauraceae), Idukki, Kerala, Jan. 10, 1982, V.B. Hosagoudar HCIO 40541; *L. wightiana*, Mahabaleshwar, Maharashtra, Feb. 1977, V.P. Kaul HCIO 33809.

Meliola livistonae Yates, Philippine J. Sci. 12: 366, 1917.
On *Livistona* sp.(Arecaceae), Basiad, Luzon, Dec. 1916, H.S. Yates HCIO 3309.

Meliola longiseta Hoehnel, Sitzb. K. Akad. Wiss. Wien, Math.-naturw. Kl. 116: 100, 1907.
On *Canthium dicoccum* var. *umbellata* (Rubiaceae), Gersoppa, Karnataka, Nov. 23, 1992, P.A. Raghu HCIO 40871.

Meliola longispora (Gaill.) Stev., Ann. Mycol. 26: 244, 1928.
On Euphorbiaceous host, Radhanagari, Maharashtra, Nov. 24, 1974, M.S. Patil HCIO 36748.

Meliola luvungae Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 239, 1990.
On *Luvunga elutherandra* (Rutaceae), Idukki, Kerala, Dec. 12, 1982, V.B. Hosagoudar HCIO 40542 (type).

Meliola luzonensis Sydow, Ann. Mycol. 15: 188, 1917.
On *Antidesma* sp. (Stilaginaceae), Province of Bataan, Luzon, Dec. 1915, M. Ramos HCIO 3310.

Meliola mabae Thite (in ed.)
On *Maba nigricans* (Ebenaceae), Castle rock, Karnataka, Dec. 1971, A.N. Thite HCIO 31911 (type).

Meliola macarangae Sydow, Ann. Mycol. 15: 188, 1917.
On *Macaranga tararus* (Euphorbiaceae), San Antonio, Luzon, Oct. 1915, M. Ramos HCIO 3311, 3313; *M. bicolor*, Prov. of Laguna, Luzon, June-August, 1915, R.C. McGregor HCIO 3312.

Meliola macarangae Sydow var. ***apayaoensis*** (Yates) Hansf., Sydowia Beih. 2: 228, 1961.
Meliola apayaoensis Yates, Philippines J. Sci. 13: 364, 1918.
On *Macaranga* sp. (Euphorbiaceae), Apayao subprovince, Luzon, May 1917, E. Fenix HCIO 3191.

Meliola machili Yamam., Trans. Nat. Hist. Soc. Formosa 31: 23, 1941.
On *Persea macrantha* (Lauraceae), Sampaje, Dec. 22, 1991, B.R. Dayal HCIO 30834.

Meliola macropoda Sydow, Ann. Mycol. 24: 296, 1926.
On *Vepris bilocularis* (Rutaceae), Gersoppa, Karnataka, Oct. 21, 1992, P.A. Raghu HCIO 40872 (p.p.).

Meliola maduraiensis Hosagoudar, Ravikumar & Lakshmanan, Nova Hedwigia 54: 269, 1992.
On *Syzygium lanceolatum* (Myrtaceae), High Wavy Mountain, Tamil Nadu, Aug. 25, 1990, V. Lakshmanan HCIO 30457 (type).

Meliola maesicola Hansf. & Stev., J. Linn. Soc. London 51: 277, 1937.
On *Maesa indica* (Myrsinaceae), Coorg, Karnataka, Feb. 2, 1968, K.H. Anahosur HCIO 31136, AMH 572.

Meliola malabarensis Hansf., Proc. Linn. Soc. London 157: 182, 1946.
On *Olea* sp. (Oleaceae), Kanouth, Tellicherry, Kerala, Sept. 26, 1904, E.J. Butler HCIO 3187; Pulyannur, Kerala, Oct. 8, 1907, E.J. Butler HCIO 1050; *O. dioica*, Anamalai, Coimbatore, Tamil Nadu, Dec. 26, 1990, V.B. Hosagoudar HCIO 30552; Sampaje, Karnataka, Feb. 15, 1992, B.R. Dayal HCIO 30839.

Meliola malacotricha Speg., Anal. Soc. Cienc. Argentina 22: 59, 1888.
Meliola hewittiae Rehm., Philippine J. Sci. 8: 253, 1913.
Meliola merremiae Rehm, Philippine J. Sci. 8: 253, 1913.
On *Hewittia sublobata* (Convolvulaceae), Luzon, Dec. 1914, E.D. Merril HCIO 3282; Dec. 1915, M. Ramos HCIO 3283; Jan. 20, 1917, E.D. Merrill HCIO 3284. *Merremia* sp., Province of Bulacan, Luzon, Sept. 1913, M. Ramos HCIO 3326.

Meliola malacotricha Speg. var. ***major*** Beeli, Bull. Jard. Bot. Bruxelles 7: 89, 1920.
On *Argyreia hookeri* (Convolvulaceae), Idukki, Kerala, Jan. 7, 1982, V.B. Hosagoudar HCIO 40545; *A. elliptica*, Nilgiris, Tamil Nadu, Jan. 24, 1990, V.B. Hosagoudar HCIO 30367; *A. setosa*, Topslip, Coimbatore, Tamil Nadu, Dec. 20, 1990, V.B. Hosagoudar HCIO 50553; *A. populifolia*, Idukki, Kerala, Jan. 7, 1982, V.B. Hosagoudar HCIO 40509; *Merremia umbellata* (Convolvulaceae), Gersoppa, Karnataka, Sept. 24, 1992, P.A. Raghu HCIO 40762.

Meliola malangasensis Hansf., Sydowia Beih. 1: 111, 1957.
On *Eugenia stocksii* (Myrtaceae), Nival, Sangli, Maharashtra, Jan. 23, 1992, C.R. Patil HCIO 40732.

Meliola mangiferae Earle, Bull. Bot. New York Bot. Gard. 3: 307, 1905.
On *Mangifera indica* (Anacardiceae), Amboina, July-Nov., 1913, C.B. Robinson HCIO 3318, 3319; Nilgiris, Tamil Nadu, Jan. 24, 1990, V.B. Hosagoudar HCIO 30368; Madikeri, Karnataka, Dec. 21, 1991, B.R. Dayal HCIO 30833.

Meliola manihoticola Henn., Hedwigia 43: 364, 1904.
On *Vitex altissima* (Verbenaceae), Tellicherry, Kerala, Dec. 1977, L,N. Nair HCIO 33810.

Meliola manni Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 408,1990.
On *Castanopsis armata* (Fagaceae), Assam, Jan. 1897, G. Mann HCIO 39434b (type, p.p.).

Meliola mapaniae Yates, Philippine J. Sci. 12: 367, 1917.
On *Mapania* sp. (Cyperaceae), Catubig river, Samar, Feb.-March, 1916, M. Ramos·HCIO 3320.

Meliola mappiae C.R. Patil (*in ed.*)
On *Mappia foetida* (Icanaceae), Bhagamandala, Karnataka, March 1, 1984, C.R. Patil HCIO 40004 (type); Feb. 1977, V.P. Kaul HCIO 33811.

Meliola mauritiae Stev. var. ***ancistrophylli*** Hansf. & Deight., Mycol. Pap. 23: 73, 1948.
On *Ancistrophyllum* sp. (Arecaceae), Gold Coast Colony, May 15, 1949, S.J. Hughes HCIO 23107.

Meliola mauritiae Stev. var. ***raphiae*** Hansf. & Deight., Mycol. Pap. 32: 73, 1948.
On *Raphia* sp. (Arecaceae), Agona, Gold coast colony, May 12, 1949, S.J. Hughes HCIO 23048.

Meliola mayapeae Stev., Illinois Biol. Monographs 2: 48, 1916.
On *Ligustrum perrotteti* (Oleaceae), Madikeri forest, Kodagu, Dec. 21, 1991, B.R. Dayal HCIO 30830.

Meliola mayapeicola .Stev. var. ***indica*** Hosagoudar, Nova Hedwigia 47: 541, 1988.
On leaves *Linoceira malabarica* (Oleaceae), Idukki, Kerala, Dec. 28, 1983, V.B. Hosagoudar HCIO 39395 (type, p.p.).

Meliola megalocarpa Sydow, Ann. Mycol. 21: 94, 1923.
On *Maba nigrescens* (Ebenaceae), Radhanagari, Kolhapur, Maharashtra, Nov. 10, 1974, M.S. Patil HCIO 31944.

Meliola memecyli Sydow, Ann. Mycol. 12: 198, 1914.
On *Memecylon lanceolatum* (Melastomataceae), Prov. of Rizal, Luzon, Aug. 1913, M. Ramos HCIO 3322, 3323, 3324, 3325.

Meliola memecyli Sydow var. ***microspora*** Hansf., Sydowia 10: 68, 1957.
On *Memecylon umbellatum* (Melastomataceae), Mahabaleshwar, Satara, Maharashtra, Feb. 1, 1984, C.R. Patil HCIO 40013.

Meliola memecylicola Hansf. var. ***indica*** Hosagoudar in Hosagoudar & Goos, Mycotaxon 42: 136, 199 .
On *Memecylon depressum* (Melastomataceae), Topslip, Anamalai, Coimbatore, Tamil Nadu, Dec. 20, 1990, V.B. Hosagoudar HCIO 30354 (type); *M. umbellatum*, Mahabaleshwar, Satara, Maharashtra, Feb. 1, 1984, C.R. Patil HCIO 40013.

Meliola melanochaeta Sydow, Ann. Mycol. 26: 93, 1928.
On *Quercus leucotrichophaora* (Fagaceae), Dolighat, Ranikhet, Uttar Pradesh, July 18, 1961, S.K. Bose HCIO 29121.; *Q. nana*, Ranikhet, Uttar Pradesh, Oct. 9, 1962, S.K. Bose HCIO 29120.

Meliola melanoxylonis Hosagoudar & Pillai in Hosagoudar, Raghu & Pillai, Nova Hedwigia 58: 540, 1994.
On *Acacia melanoxylon* (Mimosaceae), Vettiyar, Kerala, Sept. 14, 1992, C.M. Pillai HCIO 40763 (type).

Meliola millettiae-chrysophyllae Deight. var. ***indica*** Hosagoudar, Siddappa & Udaiyan, Nova Hedwigia 56: 198, 1993.
On *Millettia splendens* (Fabaceae), Jammunarai, Kotagiri, Nilgiris, Tamil Nadu, Feb. 18, 1991, V.B. Hosagoudar HCIO 30622 (type).

Meliola mitragynae Sydow, Philippine J. Sci. 8: 478, 1913.
On *Mitragyna parvifolia* (Rubiaceae), Gersoppa, Karnataka, Oct. 24, 1992, P.A. Raghu HCIO 40873.

Meliola mitrephorae Hosagoudar & Rajendran, J. Econ. Tax. Bot. 13: 75, 1989.
On *Mitrephora heyneana* (Annonaceae), Shencottah, Tamil Nadu, Dec. 15, 1987, A. Rajendran HCIO 39396 (type).

Meliola motandrae Hansf., Proc. Linn. Soc. London 143: 10, 1941.
On *Motandra guineensis* (Apocynaceae), Jasikan, British Mandated Togoland, May 27, 1949, S.J. Hughes HCIO 23037.

Meliola mucunae-acuminatae Hansf. var. ***indica*** Hosagoudar, Nova Hedwigia 56: 198, 1993.
On *Mucuna pruriens* (Fabaceae), Anmode, Maharashtra, Oct. 1974, A.N. Thite HCIO 31907 (type).

Meliola mucunae Hansf. var. ***hirsutae*** Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 240, 1990.
On *Mucuna hirsuta* (Fabaceae), Idukki, Kerala, Oct. 8, 1983, V.B. Hosagoudar HCIO 40548 (type).

Meliola mussaendae-arcuatae Hansf., Sydowa 11: 57, 1958.
On *Mussaenda arcuata* (Rubiaceae), Entebbe, Africa, May 1944, C.G. Hansford HCIO 10432.
Note: This collection is associated with *Balladynastrum entebbeensis*

Meliola myristicae Hosagoudar & Raghu (*in ed.*).
On *Myristica fatua* var. *magnifica* (Myristicaceae), Gersoppa, Uttara Kannada, Karnataka, Sept. 24, 1992, P.A. Raghu HCIO 40764 (type).

Meliola nairii in Hosagoudar & Goos, Mycotaxon 37: 409, 1990.
On *Aphanamixis polystachya* (Meliaceae), Panthenthode forest, Palghat, Kerala, Oct. 9, 1972, N.C. Nair HCIO 39439 (type).

Meliola neolitseae Yamam., Trans. Nat. Hist. Soc. Formosa 31: 24, 1941.
On *Cryptocarya wightiana* (Lauraceae), Kolhapur, Maharashtra, March 3, 1977. M.S. Patil HCIO 32523.

Meliola nephelii Sacc., Bull. Orto Bot. Napoli 6: 42, 1921.
On *Nephelium longan* (Sapindaceae), Petlond, Sangli, Maharashtra, Feb. 1981, C.R. Patil HCIO 40021.

Meliola nephelii Sacc. var. ***minor*** Patil (*in ed.*).
On *Nephelium longana* (Sapindaceae), Nivale, Sangli, Jan. 22, 1992, C.R. Patil HCIO 40734.

Meliola nephelii Sacc. var. ***singalensis*** Hansf., Sydowia 10: 80, 1957.
On *Allophyllus serrulatus* (Sapindaceae), Idukki, Kerala, Oct. 10, 1982, V.B. Hosagoudar HCIO 40550.

Meliola nilgirianthi Hosaoudar in Hosagoudar & Goos, Mycotaxon 37: 241, 1990.
On *Nilgirianthus heyneanus* (Acanthaceae), Idukki, Kerala, Dec. 25, 1983, V.B. Hosagoudar HCIO 40515 (type).

Meliola nothopegiae Hansf., Sydowia 10: 80, 1957.
On *Nothopegia racemosa* var. *racemosa* , Gersoppa, Karnataka, Oct. 21, 1992, P.A. Raghu HCIO 40874.

Meliola obtusa (Toro) Orejuela, Mycologia 37: 389, 1915.
On *Wendlandia tomentosa* (Rubiaceae), Kemmanagundi, Karnataka, Feb. 26, 1984, C.R. Patil HCIO 40019.

Meliola ochrocarpi Thite & Patil, Geophytology 13: 125, 1983.
On *Ochrocarpus longifolius* (Clusiaceae), Amboli, Ratnagiri, Maharashtra, Oct. 1980, A.N. Thite HCIO 33670 (type).

Meliola olacis Deight., Sydowia 5: 8, 1951.
On *Olax wightiana* (Olacaceae), Amboli, Maharashtra, Jan. 12, 1978, M.S. Patil HCIO 32563.

Meliola osyridicola Hansf., Proc. Linn. Soc. London 157: 184, 1946.
On *Osyris arborea* (Santalaceae), Ooty, Tamil Nadu, March 14, 1937, C.S. Krishnaswamy HCIO 10402 (type).

Meliola osyridicola Hansf. var. ***indica*** Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 410, 1990.
On *Osyris quadripartita* (Santalaceae), National Orchidarium, Yercaud, Salem, Tamil Nadu, March 1, 1984, V.B. Hosagoudar HCIO 39440 (type).

Meliola otonephelii Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 242, 1990.
On *Otonephelium stipulaceum* (Sapindaceae), Idukki, Kerala, Dec. 23, 1983, V.B. Hosagoudar HCIO 40552 (type).

Meliola palawanensis Sydow, Leafl. Philippine Bot. 5: 1539, 1912.
On *Canthium wightii* (Rubiaceae), Talakavery, Karnataka,

March 3, 1984, C.R. Patil HCIO 40017.

Meliola panici Earle, Muehlenbergia 1: 12, 1901.
Meliola substenospora Hoehn., Sitzb. K. Akad. Wiss. Wien, Math. naturw. Kl. 118: 317, 1909.
On *Rottboellia ophiuroides* (Poaceae), Bosoboso, Prov. of Rizal, Luzon, Oct. 1912, M. Ramos HCIO 3382; *Centotheca-lappacea* (Poaceae), Anamalai, Coimbatore, Tamil Nadu, Dec. 26, 1990, V.B. Hosagoudar HCIO 30555; *Lophotherum gracile* (Poaceae), Anamalai, Coimbatore, Tamil Nadu, Dec. 26, 1990, V.B. Hosagoudar HCIO 30556.

Meliola paullinicola Hansf., Sydowia 9: 46, 1955.
On Unidentified host, Petlond, Sangli, Maharashtra, Dec. 21, 1984, C.R. Patil HCIO 40020.

Meliola petchii Hansf., Proc. Linn. Soc. London 157: 182, 1946.
On *Strychnos nux-vomica* (Loganiaceae), Malabar, Kerala, T.R. Ranganathan, Nov. 17, 1912, HCIO 10488.

Meliola phaseoli Thite (*in ed.*)
On *Phaseolus khandalensis* (Fabaceae), Kolhapur, Maharashtra, Dec. 1971, A.N. Thite HCIO 31910 (type).

Meliola phyllostachydis Yamam., Trans. Nat. Hist. Soc. Formosa 31: 26, 1941.
On *Bambusa* sp. (Poaceae), Ooty, Nilgiris, Tamil Nadu, Feb.23, 1923, P.V. Somayajulu HCIO 10404.

Meliola piperae Thite & Patil, Geophytology 13: 124, 1983.
On *Piper nigrum* (Piperaceae), Amboli, Radhanagari, Maharashtra, Dec. 1980, A.N. Thite HCIO 33672.

Meliola plectroniae Hansf., Sydowia 9: 72, 1955.
On *Plectronia (Canthium) umbellata* (Rubiaceae), Matheran, Maharashtra, Date & Collector unknown, HCIO 3106.

Meliola pogostemonis Hansf., Sydowia 10: 83, 1957.
On *Pogostemon pubescens* (Lamiaceae), Idukki, Kerala, Jan. 8, 1982, V.B. Hosagoudar HCIO 40553.

Meliola polygoni Srinivasulu, Nova Hedwigia Beih. 47: 432, 1974.
On *Polygonum chinense* (Polygonaceae), Ambe Ghats, Maharashtra, Dec. 1972, A.N. Thite HCIO 31909.

Meliola polytricha Kalch. & Cooke, Grevillea 8: 72, 1879.
On *Pittosporum dasycaulon* (Pittosporaceae), North Kanara, Ghat forest, Karnataka, Oct. 1919, L.J. Sedgwick HCIO 1983.

Meliola pterocarpi Yates, Philippine J. Sci. 13: 235, 1918.
On *Pterocarpus marsupium* (Fabaceae), Kodagu, Karnataka, Dec. 22, 1991, B.R. Dayal HCIO 30835.

Meliola pterospermi Stev. var. ***microspora*** Hosagoudar & Raghu, New Botanist 20: 70, 1993.
On *Pterospermum reticulatum* (Sterculiaceae), Gersoppa, Karnataka, Oct. 21, 1992, P.A. Raghu HCIO 40892 (type).

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On *Homonoia riparia* (Euphorbiaceae), Panamkutty, Idukki, Kerala, Dec. 12, 1982, V.B. Hosagoudar HCIO 40556; Gersoppa, Uttara Kannada,Karnataka, Feb.25, 1992, P.A. Raghu HCIO 30998.

Meliola quadrispina Racib., Parasit. Algen und Pilze Java's 3: 33, 1900.
On *Argyreia elliptica* (Convolvulaceae), Idukki, Kerala, Oct. 11, 1982, V.B. Hosagoudar HCIO 40555; *A. speciosa*, Radhanagari, Kolhapur, Maharashtra, M.S. Patil HCIO 31947.

Meliola ranganathii Hansf., Proc. Linn. Soc. London 151: 185, 1946.
On *Eugenia* sp. (Myrtaceae), South Kanara, Karnataka, March, 27, 1913, T.R. Ranganath HCIO 10399(type).

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On *Mangifera indica* (Anacardiaceae), Castle rock, Karnataka. Jan. 10, 1984, C.R. Patil HCIO 40011.

Meliola rickiana Hansf. var. ***zanthoxyli*** Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 245, 1990.
On *Zanthoxylum ovata* (Rutaceae), Idukki, Kerala, Aug. 12, 1983, V.B. Hosagoudar HCIO 40557 (type); *Z. ovalifolium*, Seithur Hills, Tamil nadu, Nov. 7, 1992, V.B. Hosagoudar HCIO 40875.

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On *Entada scandens* (Fabaceae), Petlond, Sangli, Maharashtra, March 20, 1984, C.R. Patil HCIO 40012.

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Meliola roureae Yates, Philippine J. Sci. 13: 370, 1918.
On *Rourea erecta* (Connaraceae), Prov. of Bataan, Luzon, Dec. 1915, M. Ramos HCIO 33640.

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On *Connarus wightii* (Connaraceae), Anamalai, Coimbatore, Tamil Nadu, March 23, 1990, V.B. Hosagoudar HCIO 30395.

Meliola rubiella Hansf., Sydowia Beih. 1: 115, 1957.
On *Rubus* sp.(Rosaceae), Singhik, North Sikkim, April 14, 1962, J. N. Kapoor HCIO 28365; Senghila, North Sikkim, April 14, 1962, J.N. Kapoor HCIO 28365.

Meliola sacchari Ann. Mycol. 12: 548, 1914.
On *Saccharum spontaneum* (Poaceae), Subprovince Ifugo, Luzon, Feb. 1913, R.C. McGregor HCIO 3367; *Imperata cylindrica* (Poaceae), Mt. Maquiling, Prov. of Laguna, Luzon, Sept. 1910, E.D. Merrill HCIO 3366.

Meliola saccardoi Sydow, Ann. Mycol. 20: 68, 1922.
Meliola cookeana Speg. var. *saccardoi* Sydow, Ann. Mycol 2: 170, 1904.
On *Litsea glutinosa* (Lauraceae), Luzon, June 1913, M. Ramos HCIO 3249.

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On *Salacia elegans* (Celastraceae), Kisubi, Entebbe, Oct. 1944, C.G. Hansford HCIO 10606.

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On *Scaevola frutescens* (Goodeniaceae), Prov. of Tayabas, Luzon, June 26, 1913, L. Escritor HCIO 3375.

Meliola schimae Hansf., Reinwardtia 3: 107, 1954.
On *Gordonia obtusa* (Theaceae), Kemmanagundi, Karnataka, Feb. 29, 1984, C.R. Patil HCIO 40022.

Meliola salleana Hansf. var. ***smilacis*** Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 245, 1990.
On *Smilax zeylanica* (Smilacaceae), Idukki, Kerala, Jan. 11, 1982, V.B. Hosagoudar HCIO 40558 (type).

Meliola sarcostigmatis Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 246, 1990.
On *Sarcostigma kleinii* (Icacinaceae), Idukki, Kerala, Feb. 18, 1983, V.B. Hosagoudar HCIO 40561 (type).

Meliola scleropyri Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 247, 1990.
On *Scleropyrum pentandrum* (Santalaceae), Idukki, Kerala, April 25, 1982, V.S. Raju HCIO 40563 (type).

Meliola semecarpi-anacardii Hosagoudar, Kaveriappa, Raghu & Goos, Mycotaxon 51: 114, 1994.
On *Semecarpus anacardium* (Anacardiaceae), Dakshina Kannada, Mangalore, Karnataka, Nov. 24, 1992, P.A. Raghu HCIO 40877 (type).

Meliola semecarpicola Hansf., Sydowia 11: 58, 1958.
On *Semecarpus travancorica* (Anacardiaceae), Idukki, Kerala, Dec. 19, 1982, A. Diraviadoss HCIO 40562.

Meliola sempeiensis Yamam. var. ***nicobarica*** Lakshmanan, Bharghavan & Hosagoudar, J. Andaman Sci. Assoc. 6: 153, 1990.
On *Litsea* sp. (Lauraceae), Great Nicobar Islands, March 18, 1990, V. Lakshmanan HCIO 30396(type).

Meliola serjaniae Stev. var. ***major*** Hansf., Sydowia 9: 49, 1955.
On *Sapindus laurifolia* (Sapindaceae), Kasargod, Kerala, Nov. 25, 1992, J. Bhandary HCIO 40876 (type).

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On *Sersalisia edulis* (Sapindaceae), Entebbe road, Africa, May, 1944, C.G. Hansford HCIO 10430.

Meliola setariae Hansf. & Deight., Mycol. Pap. 23: 75, 1948.
On *Setaria chevalieu* (Poaceae), Kemponase, Gold Coast Colony, May 8, 1949, S.J. Hughes HCIO 23026.

Meliola setariae var. ***indica*** Sawant (*in* ed.)
On *Setaria* sp. (Poaceae), Kodaikanal, Tamil Nadu, Jan 12, 1989, R.S. Sawant HCIO 30338 (type).

Meliola shettyi Hosagoudar *et al.* (*in ed.*).
On *Actinodaphne* sp. (Lauraceae), Gersoppa, Uttara Kannada, Karnataka, May 17, 1992, C.M. Pillai HCIO 30990 (type).

Meliola simillima Ellis & Everh. in Hitchcock, Ann. Rept. Missouri Bot. Gard. p. 118, 1898.
On *Holarrhena africana* (Apocynaceae), Njala, Sierra Leone, Feb. 8, 1933, F.C. Deighton HCIO 3378.

Meliola simillima Ellis & Everh. var. ***major*** Hansf., Sydowia 10: 89, 1957.
On *Holarrhena antidysenterica* (Apocynaceae), Dacca, Bengal, March 12, 1913, A.L. Som HCIO 1988; *Hemidesmus indica* (Apocynaceae), Panhala, Maharashtra, Oct. 1980, A.N. Thite HCIO 33673.

Meliola soroceae Speg., Anal. Mus. Nac. Buenos Aires 23: 1343, 1912.
On *Bosainea phoberos* (Moraceae), Entebbe road, Uganda, Africa, Aug. 1944, C.G. Hansford HCIO 10516.

Meliola spigeliae Hansf., Sydowia 9: 49, 1955.
On *Strychnos nux-vomica* (Loganiaceae), Londa, Karnataka, Dec. 1971, A.N. Thite HCIO 31908.

Meliola staphyleacearum Hosagoudar, Nova Hedwigia 52: 502, 1991.
On *Turpinia* sp. (Staphyleaceae), Anamalai, Coimbatore, Tamil Nadu, March 23, 1990, V.B. Hosagoudar HCIO 30397 (type).

Meliola stemonuri Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 248, 1990.
On *Stemonurus tentrandrus* (Icacinaceae), Idukki, Kerala, Dec. 21, 1983, V.B. Hosagoudar HCIO 40560 (type).

Meliola stenospora Wint., Hedwigia 25: 97, 1886.
On *Strychnos nux-vomica* (Loganiaceae), Puri, Orissa, Date of collection unknown, S.K. Bal HCIO 3380; Taliparamba, Malabar, Kerala, May 27, 1952, N.V. Sundaram HCIO 20422; *Piper* sp. (Piperaceae), Gersoppa, Uttara Kannada, Oct. 20, 1992, P.A. Raghu HCIO 40888.
Note: This species is known only on Piperaceae members and the Orissa collection is to be redetermined.

Meliola stenospora Wint. var. ***major*** Hansf., Sydowia 16: 302, 1963.
On *Piper nigrum* (Piperaceae), Mahabaleshwar, Maharashtra, March 22, 1980, M.S. Patil HCIO 36749.

Meliola stephaniae Hansf., Reinwardtia 3: 93, 1954.
On *Cyclea burmanii* (Menispermaceae), Castlerock, Karnataka, Jan. 10, 1984, C.R. Patil HCIO 40014; *Stephania japonica* (Menispermaceae), Nilgiris, Tamil Nadu, Jan. 24, 1990, V.B. Hosagoudar HCIO 30369.

Meliola sterculiae Hansf. & Deight., Mycol. Pap. 23: 18, 1948.
On *Sterculia tragacantha* (Sterculiaceae), Tafo, Gold Coast Colony, June 6, 1949, S.J. Hughes HCIO 22980.

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On *Strychnos nux-vomica* (Loganiaceae), Londa, Karnataka, Dec. 1971, A.N. Thite HCIO 31908.

Meliola swieteniicola Hosagoudar *et al.* (*in ed.*)
On *Swietenia mahagoni* (Meliaceae), Kaiga, Uttara Kannada, Karnataka, Nov. 21, 1992, K.M. Kaveriappa HCIO 40878 (type).

Meliola symingtoniae Kapoor, Indian Phytopathol. 20: 158, 1967.
On *Symingtonia populnea* (Hammamelidaceae), Sikkim, India, April 1962, J. N. Kapoor HCIO 28361 (type).

Meliola symplocicola Yamam., Trans. Nat. Hist. Soc. Formosa 31: 57, 1941.
On *Symplocos cochinchinensis* ssp. *laurina* (Symplocaceae), Idukki, Kerala, Aug. 20, 1983, V.B. Hosagoudar HCIO 40564.

Meliola symphorameticola Hosagoudar, Udaiyan & Goos, Mycotaxon 51: 119, 1994.
On *Symphorema involucratum* (Symphoremaceae), Dhoni Forest, Palghat, Kerala, March 1, 1993, V.B. Hosagoudar HCIO 46881 (type).

Meliola tabernaemontanae Speg., Anal. Mus. Nac. Buenos Aires 23: 42, 1912.
Meliola wrightiae Yates, Philippine J. Sci. 13: 371, 1918.
On *Wrightia laniti* (Apocynaceae), Philippines, Jan. 28, 1946, M.A. Palo HCIO 23931; Prov. of Rizal, Luzon, Oct.-Nov., 1916, M. Ramos HCIO 3394.

Meliola tabernaemontanicola Hansf. & Thirum., Farlowia 3: 298, 1948.
On *Tabernaemontana* sp. (Apocynaceae), Balehonnur, Karnataka, Aug. 28,. 1944, M.J. Thirumalachar HCIO 10876 (type).

Meliola tamarindi Sydow, Ann. Mycol. 10: 79, 1912.
On *Tamarindus indica* (Caesalpiniaceae), Pachanadi, Mangalore, Karnataka, April 16, 1913, L.S. Mony HCIO 3383; Prov. of Rizal, Luzon, Nov. 1915, M. Ramos HCIO 3385, 3386; Idukki, Kerala, Dec. 16, 1982, V.B. Hosagoudar HCIO 40565; Sampaje, Karnataka, Dec. 22, 1991, B.R. Dayal HCIO 30840; Gersoppa, Karnataka, Nov. 13, 1992, C.M. Pillai HCIO 40879; Luzon, Manila, Feb. 1912, E.D. Merrill HCIO 3384.

Meliola tayabensis Yates, Philippine J. Sci. 12: 369, 1917.
On *Linoceira* sp. (Oleaceae), Prov. of Tayabas, Luzon, Dec. 1916, H.S. Yates HCIO 3387.

Meliola tecleae Hansf. var. ***toddaliae-asiaticae*** Hansf., Proc. Linn. Soc. London 153: 11, 1941.
On *Toddalia asiatica* (Rutaceae), Idukki, Kerala, Dec. 12, 1982, V.B. Hosagoudar HCIO 40567.

Meliola telosmae Rehm, Philippine J. Sci. 8: 392, 1913.
On *Telosma ?* (Asclepiadaceae), Luzon, July-Aug., 1915, M. Ramos HCIO 3388.

Meliola telosmae Rehm var. ***indica*** Hosagoudar *et al. (in ed.).*
On *Tylophora tenuis* (Asclepiadaceae), Radhanagari, Kolhapur, Maharashtra, Jan. 21, 1975, A.N. Thite HCIO 31946 (type).

Meliola tenella Pat. var. ***atalantiae*** (Pat.) Hansf., Proc. Linn. Soc. London 158: 35, 1946,
On *Atalantia monophylla* (Rutaceae); Coimbatore, April, 17, 1990, V.S. Ramachandran HCIO 30398.

Meliola tenella Pat. var. ***atalantiicola*** Hosagoudar, J. Econ. Tax. Bot. 11: 159, 1987.
On *Atalantia monophylla* (Rutaceae), Tummalabailu, Nallamalai, Kurnool, Andhra pradesh, April 19, 1986, V.B. Hosagoudar HCIO 39312(type).

Meliola tenella var. ***microspora*** Patil (*in ed.*).
On *Murraya exotica* (Rutaceae), Nivale, Sangli, Maharashtra, Jan. 23, 1992, C.R. Patil HCIO 40731 (type).

Meliola teramni Sydow, Ann. Mycol. 15: 193, 1917.
Meliola teramniae Yates, Philippine J. Sci. 12: 369, 1918.
On *Teramnus labialis* (Fabaceae), Luzon, March 1916, H.S. Yates HCIO 3389.

Meliola teramni Sydow var. ***millettiae*** Hosagoudar in Hosagoudar & Goos, Mycotaxon 42: 137, 1991.
On *Millettia rubiginosa* (Fabaceae), Anamalai, Coimbatore, Tamil Nadu, Dec. 27, 1990, V.B. Hosagoudar HCIO 30559 (type).

Meliola terminaliae Thite (*in ed.*).
On *Terminalia paniculata* (Combretaceae), Radhanagari, Maharashtra, 1971, A.N. Thite HCIO 31631 (type).
Note: The host name was written as *Terminalia bellarica.* The generic identity of the fungus is to be confirmed.

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On *Schima* sp. (Theaceae), Penang foot hills, Malaya, July 1918, E.J. Butler HCIO 1982.

Meliola themedae Stev. & Rold. ex Hansf. var. ***indica*** Hosagoudar in Hosagoudar & Goos, Mycotaxon 37: 249, 1990.
On *Themeda cymbaria* (Poaceae), Idukki, Kerala, Jan. 8, 1982, V.B. Hosagoudar HCIO 40568 (type).

Meliola thirumalacharii Hosagoudar & Rajendran, J. Econ. Tax. Bot. 13: 76, 1989.
On *Microcos paniculata* (Tiliaceae), Shencottah, Tamil Nadu, Dec. 15, 1987, A. Rajendran HCIO 39397 (type).

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On *Thunbergia alata* (Thunbergiaceae), Entebbe, Africa, Oct. 1944, C.G. Hansford HCIO 10593.

Meliola thwaitesiana Hansf., Sydowia 10: 94, 1957.
On *Ixora coccinia* (Rubiaceae), Radhanagari, Maharashtra, Oct. 1970, A.N. Thite HCIO 31629.

Meliola toddaliae Doidge, Trans. Royal Soc. South Africa 5: 732, 1916.
On *Pamburus missionis* (Rutaceae), Tropical Botanic Garden and Research Institute, Palode, Thiruvananthapuram, Kerala, Nov. 20, 1992, A.G. Pandurangan HCIO 40890.

Meliola toddaliicola Hansf. var. ***indica*** Hansf. & Thirum., Farlowia 3: 299, 1948.
On *Toddalia aculeata* var. *floribunda* (Rutaceae), Balehonnur, Karnataka, April 29, 1945, M.J. Thirumalachar HCIO 10865.

Meliola toxocarpi Hosagoudar & Antony, J. Swamy Bot. Club 5: 75, 1988.
On *Toxocarpus beddomei* (Asclepiadaceae), Upper Godayar, Kanyakumari, Tamil Nadu, March 14, 1979, A.N. Henry HCIO 40566

Meliola trachelospermi Yates, Philippine J. Sci. 13: 370, 1918.
On *Trachelospermum* sp. (Apocynaceae), Mt. Lumutan, Prov. of Rizal, Luzon, July 1917, M. Ramos & G.Edano HCIO 3390.

Meliola transvaalensis Doidge, Bothalia 2: 238, 1928.
On *Myrsine africana* (Myrsinaceae), Chaubattia, Oct. 15, 1959, J.N. Kapoor HCIO 26895.

Meliola travancoricae Hosagoudar in Hosagoudar & Goos, Mycotaxon 42: 138, 1991.
On *Semecarpus travancorica* (Anacardiaceae), Anamalai, Coimbatore, Tamil Nadu, Dec. 26, 1990, V.B. Hosagoudar HCIO 30560 (type).

Meliola trewiae Hosagoudar in Hosagoudar & Goos, Mycotaxon 42: 138, 1991.
On *Trewia polycarpa* (Euphorbiaceae), Anamalai, Coimbatore, Tamil Nadu, Dec. 26, 1990, V.B. Hosagoudar HCIO 30561 (type); *T. nodiflora*, Anamalai, Tamil Nadu, Dec. 26, 1990, V.B. Hosagoudar HCIO 30562 (isotype).

Meliola trichostachyonsis Patil (*in ed.*).
On *Piper trichostachyon* (Piperaceae), Petlond, Sangli, maharashtra, March 20, 1984, C.R. Patil HCIO 40005 (type).

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On *Psidium gaujava* (Myrtaceae), Brasil, Jan. 28, 1908, C.F. Baker HCIO 3351.

Meliola trifurcata Cifferi, Ann. Mycol. 36: 226, 1938.
On *Carapa procera* (Meliaceae), Aburi, Gold coast colony, May 3, 1949, S.J. Hughes HCIO 22976.

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On *Tylophora capparidifolia* (Asclepiadaceae), Idukki, Kerala, Feb. 21, 1983, V.B. Hosagoudar HCIO 40569 (type).

Meliola uvariicola Hansf., Proc. Linn. Soc. London 157: 24, 1945.
On *Popowia mabierensis* (Annonaceae), Entebbe, Africa, Aug. 1944, C.G. Hansford HCIO 10540; Kawanda, June 1944, collector unknown, HCIO 10517.

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On *Ventilago africana* (Rhamnaceae), Entebbe, Africa, Aug. 1944, C.G. Hansfrod HCIO 10532.

Meliola vepridis Hosagoudar, Kaveriappa, Raghu & Goos, Mycotaxon 51: 116, 1994.
On *Vepris bilocularis* (Rutaceae), Gersoppa, Karnataka, Oct. 21, 1992, P.A. Raghu HCIO 40880 (type).

Meliola vicina Sydow, Ann. Mycol. 21: 95, 1923.
On *Mussaenda arcuata* (Rubiaceae), Oct. 1944, C.G. Hansford HCIO 10610.

Meliola villeresiicola Henn., Hedwigia 36: 218, 1907.
On *Exacum bicolor* (Gentianaceae), Radhanagari, Maharashtra, August 4, 1976, M.S. Patil HCIO 36750.

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Meliola asterinoides Wint. var. *major* Gaill., Le Genre *Meliola* p. 58, 1892.
On *Webera corymbosa* (Rubiaceae), Bilikere, Karnataka, Sept. 19, 1903, E.J. Butler HCIO 1035; *Tarenna asiatica* (Rubiaceae), Pamba, Kerala, Oct. 10, 1983, V.B. Hosagoudar HCIO 40570.

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On *Wendlandia notoniana* (Rubiaceae), Idukki, Kerala, April 18, 1982, V.B. Hosagoudar HCIO 40571 (type).

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On *Zanthoxylum ovalifolium* (Rutaceae), Talgum, Karnataka, Oct. 29, 1911, G.S. Kulkarni HCIO 3189; *Z. tetraspermum*, Kollimalai, Tamil Nadu, Nov. 1, 1914, J.S. Gamble HCIO 30563.

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Meliola zizyphi Hansf. & Thirum., Farlowia 3: 299, 1948.
On *Zizyphus rugosa* (Rhamnaceae), Balehonnur, Karnataka, April 28, 1945, M.J. Thirumalachar HCIO 10879 (type); *Z.*

xylopyrus, Idukki, Kerala, Dec. 28, 1983, V.B. Hosagoudar HCIO 40572.

Meliola sp.

On *Embelia robusta* (Myrsinaceae), Amboli, Dec. 1971, A.N. Thite HCIO 31912; *Eugenia* sp. (Myrtaceae), Bhagamandala, Karnataka, March 3, 1984, C.R. Patil HCIO 40023.

Prataprajella turpiniicola (Hosagoudar) Hosagoudar, Nova Hedwigia 55: 225, 1992.

On *Turpinia malabarica* (Staphyleaccae), Idukki, Kerala, April 4, 1982, V.B.Hosagoudar HCIO 40483 (type).

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THE LICHEN GENUS PERTUSARIA (LICHENISED ASCOMYCOTINA) IN PAPUA NEW GUINEA

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ABSTRACT: A preliminary account of the lichen genus *Pertusaria* in Papua New Guinea is given. Twenty-one taxa are reported, including the five new species and one new variety: *Pertusaria anomalospora*, *Pertusaria buloloensis*, *Pertusaria cicatricosa* Müll.Arg. var. *deficiens*, *Pertusaria damiensis*, *Pertusaria kaindiensis* and *Pertusaria plethocarpa.* A key to the taxa is provided.

INTRODUCTION

Papua New Guinea is the eastern half of a large island to the north of Australia, lying south of the Equator between latitudes 4°S and 10°S and rising to 4509 m at its highest point, Mount Wilhelm, in the centre of the country. A detailed account of the topography, geology, climate and vegetation of Papua New Guinea is given by Lambley (Lambley 1991).

The lichen genus *Pertusaria* in Papua New Guinea has received little attention. Mattick (1942) gave a brief account of the history of lichenological exploration in New Guinea but *Pertusaria* was not among his list of genera collected on the main island. Szatala, in his account of the lichen flora of New Guinea (Szatala 1956) recorded only one species, *P. rechingeri* Zahlbr. (Zahlbruckner 1911). Thirty years later the Catalogue of the lichens of Papua New Guinea and Irian Jaya (Streimann 1986) recorded only one additional species, *P. gyalectoides* Vezda (Weber 1971). More recent accounts (Streimann 1990, Aptroot & Sipman 1991) contain no mention of *Pertusaria* ; however *P. epitheciifera* Sipman, first reported from Malaysia, was listed by Sipman (Sipman 1993).

This account is based mainly on collections made by two of the authors (JAE and HS) in 1981, 1982, 1983 and 1989 and specimens collected by L.K. Wade in 1967, and S.W. Kolema in 1984. The majority of the specimens are in ANUC or CANB with some duplicates in B and LAE. Chemistry was determined by thin layer chromatography (Elix & Ernst-Russell 1993) and liquid chromatography (Feige et al.1993). A key to the taxa is given.

PERTUSARIA TAXA IN PAPUA NEW GUINEA.

Pertusaria anomalospora A.W. Archer, Elix & Streimann, sp. nov. Fig.1

Thallus albido-olivaceus, superficies laevis et nitida, isidiis et sorediis destitutus, corticola; apothecia verruciformia, valde plano-hemisphaerica, raro confluentia, 1-1.7 mm diam.; ostiola inconspicua, nigra, in verrucas 1-2na; sporae 8nae, ellipsoideae, biseriatae, parietibus interioribus undulatis ("asper" sensu Dibben 1980), 105-135 μm longae, 37-45 μm latae.
Thallus chlorolichexanthona sola continens.

Type: PAPUA NEW GUINEA, New Britain, Hoskins, 5°26'S, 150°25'E, alt. 2 m, on base of coconut on sea shore, *H. Streimann 40229 p.p.*, 17.ii.1989; holo: CBG 8911051 p.p.; iso: B.

Thallus pale olive green, surface smooth and shiny, lacking isidia and soralia, corticolous; *apothecia* verruciform, inconspicuous, very flattened hemispherical, rarely confluent, slightly concave above, 1-1.7 mm diam.; *ostioles* inconspicuous, black 1(-2) per verruca; *spores* 8 per ascus, ellipsoid, 2-seriate, rough, 105-135 μm long, 37-45μm wide.

Chemistry: 2,5-dichlorolichexanthone (major), 4,5-dichlorolichexanthone (major), 2,4-dichlorolichexanthone (minor) and 2-chlorolichexanthone (trace).

The species is characterised by its chemistry and, in particular, the asci with eight rough spores. Although species with four, or two, rough spores per ascus are known (Dibben 1980), this is the only *Pertusaria* species found so far to have eight spores of this type per ascus.
Pertusaria anomalospora is known only from the type specimen.

Pertusaria buloloensis A.W. Archer, Elix & Streimann, sp. nov. Fig.2

Pertusarae verdonii A.W. Archer similis sed ab hac specie thallo albescente et acido subpicrolichenico continente differt.

Type: PAPUA NEW GUINEA, Morobe Province, Nauti logging area, Upper Watut River, 10 km S of Bulolo, 7°16'S, 146°36'E, alt. 1300 m, *H. Streimann 17124*, 3.iii.1982; holo: CBG 8201252; iso: LAE.

Thallus off-white to pale fawn, surface smooth and shiny, sorediate, lacking isidia; corticolous; *soralia* numerous, scattered, inconspicuous, 0.2-0.5 mm diam.; *apothecia* not seen.

Chemistry: K-, KC+ violet, C-, P-; picrolichenic acid (major), subpicrolichenic acid (major), isosubpicrolichenic acid (trace) ± lichexanthone (trace-minor).

Specimens examined:
PAPUA NEW GUINEA, New Britain, Laliti Mountain, Nakanai Mountains, 40 km SE of Hoskins, 5°42'S, 150°41'E,alt. 240 m, on large tree, *H. Streimann 41023*, 21.ii.1989 (CBG 8911840); *ibid.*, *H. Streimann 41027*, 21.ii.1989 (CBG 8911843); Morobe Province, Heads Hump, 4 km SE of Bulolo, 7°13'S, 146°41'E, alt. 780 m, on *Araucaria hunsteinii*, *J.A. Elix 11916*, 3.xii.1982 (ANUC); *ibid.*, on *Grevillea papuana*, *H. Streimann 17840 p.p.*, 22.iii.1982 (B, CBG 8202629, LAE); *ibid.*, on *Lithocarpus*, *H. Streimann 17847*, 22.iii.1982 (CBG 8202636, LAE); *ibid.*, on *Calophyllum soulattri*, *H. Streimann 17174*, 3.iii.1982 (CBG 8201302, LAE).

The pale thallus and the presence of subpicrolichenic acid distinguish *P.buloloensis* from the somewhat similar *P. verdonii* A.W. Archer (Elix et al. 1992) which has a green thallus and contains superpicrolichenic acid. *Pertusaria buloloensis* is distinguished from the Northern Hemisphere *P. amara* (Ach.) Nyl. by the presence of lichexanthone and the absence of protocetraric acid.

Pertusaria ceylonica Müll.Arg., *Flora* **67**: 351 (1884).

Type: CEYLON [Sri Lanka], *s. loc.*, *G. Thwaites s.n.*, 1876; holo: G.

Pertusaria trisperma Müll.Arg., *Flora* **67**: 398 (1884).
Type: CEYLON [Sri Lanka], *s. loc.*, *G. Thwaites s.n.*, 1876; holo: G.

Pertusaria impressula Müll.Arg., *Flora* **67**: 460 (1884).
Type: CEYLON [Sri Lanka], *s. loc.*, *G. Thwaites s.n.*, 1876; holo: G.

Pertusaria blumeana Müll.Arg., *Hedwigia* **31**: 281 (1892).
Type: JAVA [Indonesia] *s. loc.*, *Blume s. n.*, 1891; holo: G.

Thallus pale greenish grey, slightly areolate and cracked, surface smooth and shiny, lacking isidia and soredia, corticolous; *apothecia* verruciform, numerous, scattered or sometimes confluent, concolorous with the thallus, flattened hemispherical, 0.4-0.6 mm diam.; *ostioles* black, punctiform, 1, or rarely 2, per verruca; *spores* usually 3, rarely 4, per ascus, ellipsoid, smooth, uniseriate, 75-100 μm long, 30-45, rarely to 50, μm wide.

Chemistry: K+ weak yellow, KC-, C -, Pd+ weak yellow; 2,5-dichlorolichexanthone and stictic acid, with constictic acid, 2,4-dichlorolichexanthone and 2,4,5-trichlorolichexanthone as minor compounds.

Specimens examined:
PAPUA NEW GUINEA, New Britain, Hoskins, 5°26'S, 150°25'E, alt. 2 m, on coconut on sea shore, *H. Streimann 40229 p.p.*, (B, CBG 8911051).
AUSTRALIA, Queensland, Machans Beach, N of Cairns, 16°51'S, 145°45'E, alt. ca 2 m, on *Hernandia peltata*, *H. Mayrhofer 11419, 11421*, 6.viii.1993 (GZU).

Pertusaria ceylonica is a tropical to subtropical species characterised by the predominantly three-spored asci and the presence of stictic acid and 2,5-dichlorolichexanthone. It also occurs in Sri Lanka, Indonesia and northern Australia.

Pertusaria cicatricosa Müll.Arg. var **deficiens** A.W. Archer, Elix & Streimann, var. nov. Fig.3

Haec varietas ad illem speciem pertinentem sed a varietate *cicatricosa* xanthonis continentibus differt.

Type: PAPUA NEW GUINEA, Morobe, Papua New Guinea Forestry College, Bulolo, on citrus tree in abandoned orchard, 7°10'S, 146°40'E,alt. 710 m, *J.A. Elix 12321 & H. Streimann*, 7.xii.1982; holo: CANB.

Thallus greyish green, thin, somewhat cracked, surface smooth and dull, lacking isidia and soredia, corticolous; *apothecia* verruciform, conspicuous, scattered, rarely confluent, subhemispherical, 1-1.5 mm diam.; *ostioles* inconspicuous, pale, 1 per verruca; *spores* 2 per ascus, ellipsoid, rough, 110-125 μm long, 35-40 μm wide.

Chemistry: K-, KC-, C-, Pd-; stictic acid (major), constictic acid (minor), cryptostictic acid (minor), menegazziaic acid (trace).

Pertusaria cicatricosa Müll.Arg. is a tropical to subtropical species found in Socotra, Mauritius, north-eastern Australia, New Caledonia, Vanuatu and Fiji (Archer 1992) and is characterised by asci with two rough spores and the presence of chlorinated lichexanthones and stictic acid. The new variety, which is so far known only from the type specimen, is distinguished from var. *cicatricosa* by the absence of the chlorinated lichexanthones.

Pertusaria damiensis A.W. Archer, Elix & Streiman, sp. nov. Fig.4

Pertusarae pertusellae Müll.Arg. similis sed ab hac specie ostiolis nigras et acido 2-*O*-methylperlatolico continente differt.

Type: PAPUA NEW GUINEA, New Britain, Dami Forestry Station, 20 km ENE of Kimbe, 5°31'S, 150°19'E, alt. 10 m, on *Poinsettia* stem, *H. Streimann 41671*, 27.ii.1989; holo: CBG 8912468.

Thallus dull olive green, surface smooth and shiny, lacking isidia and soredia, corticolous; *apothecia* verruciform, numerous, crowded, often confluent, flattened hemispherical, constricted at the base, slightly concave above, 0.4-0.6 mm diam.; *ostioles* black, 1 per verruca; *spores* 2, (rarely 3) per ascus, ellipsoid, smooth, 80-105 (-120) μm long, 30-37 μm wide.

Chemistry: K-, KC-, C-, P-; 2-chlorolichexanthone (major), 4,5-dichlorolichexanthone (major), 2,5-dichlorolichexanthone (minor), 2,4,5-trichlorolichexanthone (minor), 5-chlorolichexanthone (trace), 2-*O*-methylperlatolic acid (major), 2-*O*-methylstenosporic acid (trace), stictic acid (major), constictic acid (minor), cryptostictic acid (trace), menegazziaic acid (trace).

The single black ostioles and the presence of 2-*O*-methylperlatolic acid distinguish *P. damiensis* from the somewhat similar *P. pertusella* Müll.Arg. (Müller 1884, Archer 1992) which however has numerous pale ostioles and lacks 2-*O*-methylperlatolic acid. The new species is known only from the type specimen.

Pertusaria epitheciifera Sipman, *Tropical Bryology* **8**: 301 (1993).

Type: MALAYSIA, Sabah, Mount Kinabalu, 6°05'N, 116°35'E, alt. ca. 3200 m, *H.J.M. Sipman 31234*, 12.v.1989; holo: B; iso: SNP.

Thallus pale grey to white, dull, smooth or tuberculate, corticolous; *apothecia* disciform, numerous, 1-2(-3) mm diam., *disc* pale pinkish to yellowish brown, white-pruinose; *spores* 8 per ascus, 2-seriate, 30-50 μm long, 15-25 μm wide.
A more detailed description is given by Sipman, loc. cit.

Chemistry: K+ yellow, KC-, C-, Pd+ yellow; thamnolic acid.

Sipman (loc. cit.) reported 3 specimens, collected by A. Aptroot, from the Eastern Highlands Province, Madang Province and Simbu Province at altitudes of 2300-2800 m. *Pertusaria epitheciifera* occurs in the sub-alpine zone in Malaysia and Papua New Guinea. The species is similar to the Australian *Pertusaria thamnolica* A.W. Archer (Archer 1992) but the spores in this species are uniseriate, 22-32 μm long and 12-17 μm wide

Pertusaria gyalectoides Vezda, in W.A. Weber, *Bryologist* **74:** 191 (1971).

Type: NEW GUINEA, Eastern Highlands, Mount Wilhelm, Lake Aunde, 11,300ft, [3444 m] on *Podocarpus compactus*, *W.A. Weber & D. McVean*, 26.vi.1968, Lich. Exsicc. COLO No. 358a ; holo: COLO; iso: HO.

Thallus thin, off-white, verruculose, dispersed, lichenicolous; *apothecia* disciform, 0.5-0.7 mm diam.; margins thick; disc pale orange; *spores* 8 per ascus, ellipsoid, 45-50 μm long, 25-28 μm wide; spore wall 5 μm thick.

Chemistry: K-, KC-, C-, P-; no lichen compounds present.

Pertusaria gyalectoides somewhat resembles *Pertusaria jamesii* Kantvilas from Tasmania (Kantvilas 1990) but is distinguished from that species by the larger spores. The species is so far known only from the type specimens.

Pertusaria hypothamnolica Dibben, *The Chemosystematics of the Lichen Genus Pertusaria in North America North of Mexico*: 57 (1980).

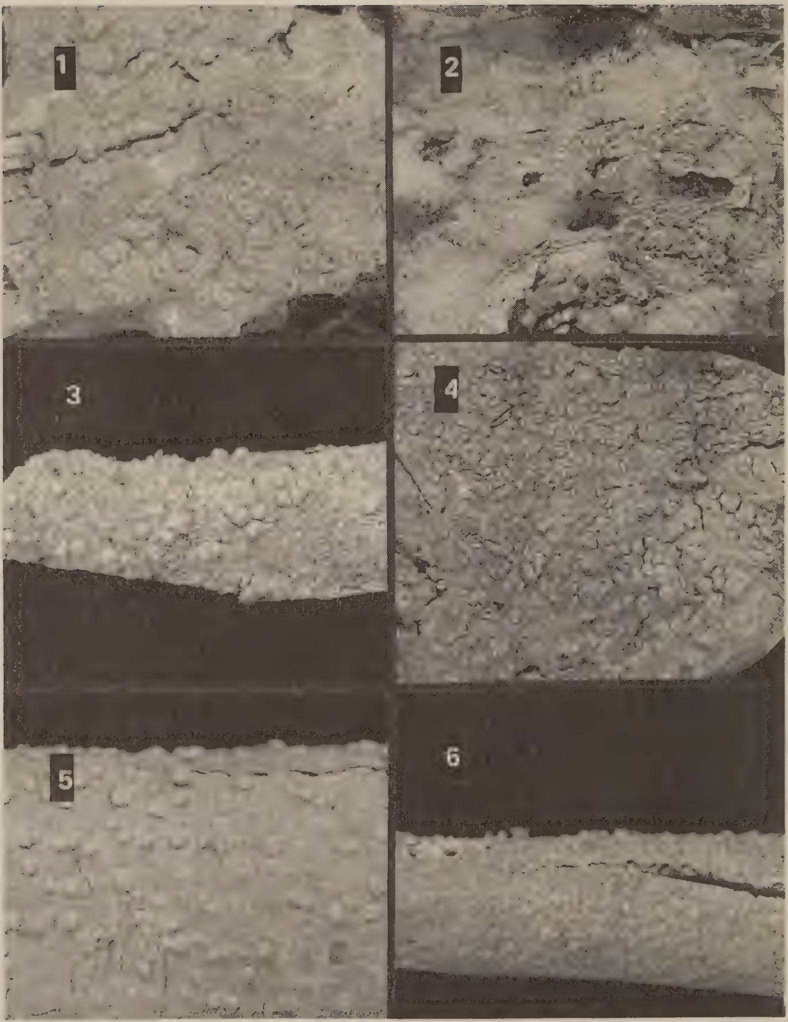
Type: U.S.A., Illinois, Randolph County, Rock Castle Creek, 1.5 miles N of Wine Hill, on oak in dry woods, *Skorepa 4244*; holo: DUKE; iso: DIBB, SIU, SKOR.

Thallus ash grey, surface smooth or tuberculate, shiny, continuous or rarely fissured, corticolous, sorediate, lacking isidia; *apothecia* disciform, concolorous with the thallus, numerous and crowded, 0.6-2 mm diam.; *discs* dark and sunken, usually heavily white pruinose, becoming sorediate; *spores* 1 (rarely 2) per ascus, 140-190 μm long, 35-50 μm wide.

Chemistry: K+ violet, KC+ violet, C-, P-; hypothamnolic acid ± lichexanthone.

Dibben (loc. cit.) reported *P. hypothamnolica* to be indigenous to eastern North America but the taxon may be synonymous with *P. tropica* Vainio (Vainio 1901: 404) [syntype: Angola, Pungo Andongo, 2400-3800 ft., *F. Welwitsch 429*, 1857 (TUR-V 6672)], a disciform, corticolous species with hypothamnolic acid and lichexanthone, and one-spored asci (fide Vainio, *loc. cit.*). Both of these taxa are distinguished from the somewhat similar *P. novaezelandiae* Szatala (Szatala 1939) by the presence of lichexanthone and their distribution; *Pertusaria novaezelandiae* has not been found north of Brisbane (Australia), 27°30'S. The specimens of *P. hypothamnolica* from Papua New Guinea included a single fertile specimen and this contained only hypothamnolic acid. This specimen may be the disciform *Pertusaria pulchretincta* Zahlbr. (Zahlbruckner 1928) from Java which was reported to react K+ violet, suggesting the presence of hypothamnolic acid. However, the two syntypes were sterile (Zahlbruckner, loc. cit.) and the specimens are not available from W for examination. *Pertusaria pulchretincta* may be a later name for *P. bengalensis* Vainio from Thailand (Vainio 1907), a sterile species containing hypothamnolic acid. *Pertusaria hypothamnolica* occurs in south-eastern United States, Papua New Guinea and Australia.

Specimens examined:
PAPUA NEW GUINEA, Morobe Province, 4 km ESE of Bulolo, 7°12'S, 146°41'E, alt. 780 m, on *Pittosporum*, *J.A. Elix 11882*, 3.xii.1982 (ANUC) [without lichexanthone]; Morobe Province, Spreader Divide, Aseki-Menyama Road, 9 km NW of Aseki, 7°18'S, 146°08'E, alt. 2180 m, on dead wood, *J.A. Elix 12088*, 5.xii.1982 (ANUC) [without lichexanthone, fertile]; New Britain, Laliti Mountain, Nakanai Mountains, 40 km SE of Hoskins, 5°42'S, 150°41'E,alt. 240 m, on *Homalium foetidum*, *H. Streimann 41269, 41274, 41285*, 21.ii.1989 (B; CBG 8912056, 8912077, 8912093) [with lichexanthone]. AUSTRALIA, Queensland, north end of Hichinbrooke Island, on *Ceriops*, *G.N. Stevens s.n.*, 24.viii.1979 (BRI).[sterile, with lichexanthone].



Figs. 1-6. New Pertusaria taxa.
1. *P. anomalospora*, X1.8; 2. *P. buloloensis*, X1.6; 3. *P. cicatricosa* var. *deficiens*, X2.2; 4. *P. damiensis*, X1.8; 5. *P. kaindiensis*, X2.7; 6. *P. plethocarpa*, X2.5.

Pertusaria kaindiensis A.W. Archer, Elix & Streimann, sp. nov. Fig.5

Pertusarae pycnophorae Nyl. similis sed ab hac specie sporis longioribus et biseriatis.

Type: PAPUA NEW GUINEA, Morobe Province, Mt Kaindi, 5 km W of Wau, 7°21'S, 146°41'E, alt. 2360 m, on tree trunk on ridge, *H. Streimann 17644*, 13.iii.1982; holo: CBG 8201810; iso: B, LAE.

Thallus off-white to pale fawn, slightly cracked, surface smooth and dull, lacking isidia and soredia, corticolous; *apothecia* disciform, numerous, scattered, rarely confluent, 0.5-1 mm diam., *discs* pale orange, white pruinose; *spores* 8 per ascus, ellipsoid, irregularly 2-seriate, 58-75 μm long, 18-25 μm wide; spore wall 2 μm thick.

Chemistry: K-, KC+ orange-red, C+ red, Pd-; lecanoric acid (major), orsellinic acid (trace) ± lichexanthone (trace-minor).

Specimens examined:
PAPUA NEW GUINEA, Southern Highlands, Lama sawmill, 6 km SE of Ialibu, 6°20'S, 144°01'E, alt. 1840 m, on *Castanopsis*, *J.A.Elix 12815 & H. Streimann*, 11.xii.1982 (ANUC); *ibid*., in montane forest on dead twigs, *J.A. Elix 12842 & H. Streimann*, 11.xii.1982 (ANUC); Tari-Komo Road, 17 km SW of Tari, 5°56'S, 142°49'E, alt. 1450, in lower montane forest on dead twigs, *J.A. Elix 13299 & H. Streimann*, 16.xii.1982 (ANUC).

Pertusaria kaindiensis is distinguished from *P. pycnophora* Nyl. (see below) by the larger biseriate spores and the absence of slightly stipitate apothecia.

Pertusaria leiocarpella Müll.Arg., *Bull. Herb. Boissier* **3**: 636.

Type: AUSTRALIA, Queensland, *s. loc*., *C. Knight 11*, 1887; holo: G.

Thallus pale olive green, slightly cracked, surface slightly wrinkled and dull, lacking isidia and soredia, corticolous; *apothecia* verruciform, numerous, conspicuous, crowded, sometimes confluent, 0.4-0.8 mm diam.; *ostioles* inconspicuous, pale, 1 per verruca; *spores* 8 per ascus, irregularly 2-seriate, ellipsoid, smoth, 60-80 μm long, 25-35 μm wide.

Chemistry: K-, KC-, C-, Pd-; 4,5-dichlorolichexanthone (minor), stictic acid (major), constictic acid (minor), menegazziaic acid (trace).

Specimen examined:
PAPUA NEW GUINEA, Morobe Province, Bulolo Airstrip, on branch of large *Albizia falcataria*, *H. Streimann 17887*, 1.iv.1982 (B, CBG 8202676, H, LAE, LSU, US).

Pertusaria leiocarpella Müll.Arg. is characterised by the eight biseriate spores and by its chemistry. It also ocurs in north-eastern Australia (Archer 1991).

Pertusaria microstoma Müll.Arg., *Flora* **65**: 328 (1884)

Type: JAVA [Indonesia] *s. loc*., *hb. Lugd. Bat*., 1882; holo: G

Thallus olive green, areolate and cracked, surface dull and tuberculate due to numerous confluent verrcae, corticolous; *apothecia* verruciform, conspicuous, numerous, crowded, often confluent, single verrucae 0.4-0.7 mm diam., flattened hemispherical, sometimes constricted at the base; confluent verrucae 1-1.5 mm diam.; *ostioles* conspicuous, black, 0.05-0.1 mm diam., sometimes with a hyaline periostiolar zone; *spores* 4 per ascus, ellipsoid, rough, 82-105(-135) μm long, 35-45 μm wide; rarely 1 per ascus, 250 μm long and 45 μm wide.

Chemistry: K-, KC-, C-, Pd-; 4,5-dichlorolichexanthone (minor), 2'-*O*-methyperlatolic acid (major), stictic acid (major), constictic acid (minor).

Specimens examined:
PAPUA NEW GUINEA, Eastern Highlands Province, Waiopa, Aiyura-Omaura Road, 13 km SE of Kainautu, 6°22'S, 145°58'E, alt. 1450 m, on rotten log, *J.A. Elix 12410*, 8.xii.1982 (ANUC); Upper Watut logging area, 12 km SE of Bulolo, 7°19'S, 143°37'E, alt. 1720 m, *H. Streimann 33077*, 2.i.1983 (B, CBG 9201718).
NEW CALEDONIA, Balade, *Vieillard s.n.*, 1855-60 (H).

Pertusaria microstoma is characterised by asci with four rough spores, conspicuous black ostioles and by its chemistry. The specimen from New Caledonia was originally identified as *P. leioplaca* var. *trypetheliiformis* Nyl. (*in sched.*). *Pertusaria microstoma* also occurs in Indonesia, Australia [north-eastern Queensland] and New Caledonia.

Pertusaria modesta Müll.Arg., *Flora* **67**: 352 (1884)

Type: VENEZUELA, Caracas, *A.Ernst, s.n.* 1878; holo: G

Pertusaria depressa sensu Müll.Arg.,*Flora* **67**: 352 (1884)
[non *Pertusaria depressa* (Fée) Mont. & v.d. Bosch apud Jungh., *Plant Junghuhn.* **4**: 482 (1855)

Pertusaria leioplaca (Ach.) DC. in Lam. & DC. var. *depressula* Müll.Arg., *Flora* **64**: 517 (1881)

Type: BRAZIL, Apiahy [Apiai], *J.I. Puiggari 1470*, May 1880; holo: G

Pertusaria melaleuca (Sm. & Sowerby) Duby var. *tetramera* Müll. Arg., *Flora* **67**: 287 (1884)

Syntypes: BRAZIL, Apiahy [Apiai], *J.I. Puiggari s.n.*; CUBA, *C. Wright* ; G

Thallus pale olive green, areolate and cracked, surface smooth and dull, corticolous; *apothecia* verruciform, numerous, conspicuous, concolorous with the thallus, crowded, sometimes confluent, flattened hemispherical, usually concave above, 0.4-1.0 mm diam.; *ostioles* black, conspicuous, 1-2(-5) per verruca; *spores* 4 per ascus, ellipsoid, smooth, 90-115(-135) μm long, 30-45(-50) μm wide.

Chemistry: K-, KC-, C-, Pd-; lichexanthone (minor-major), 2-chlorolichexanthone (minor-major), stenosporic acid (trace), 2-*O*-methylperlatolic acid (minor), perlatolic acid (trace), 2-*O*-methyhyperlatolic acid (minor-major), 2-*O*-methylsuperlatolic acid (major).

Specimens examined:
PAPUA NEW GUINEA, Morobe Province, Voco Point, Lae, 6°44'S, 147°00'E, sea-level, on *Leucaena leucocephala* along the foreshore; *J.A. Elix 11814 & H. Streimann*, 2.xii.1982 (ANUC); Papua New Guinea Forestry College, Bulolo, 7°10'S, 146°40'E, alt. 710 m, on *Caliandra* in maintained garden, *J.A. Elix 12352 & H. Streimann*, 7.xii.1982 (ANUC).

Pertusaria modesta is characterised by the four spored asci and the presence of higher homologues of perlatolic acid. It also occurs in northern Australia, Venezuela, Brazil and Cuba.

Pertusaria montpittensis A.W. Archer, *Proc. Linn. Soc. N.S.W.* **113**(1): 65

Type: NORFOLK ISLAND, Mt. Pitt Reserve, Mt. Bates summit trail, on *Elaeodendron*, in mixed subtropical rainforest, 29°00' S, 167°56'30" E, alt. 300 m, *J.A. Elix 18641*, Dec 1984; holo ANUC.

Thallus pale olive-green to pale yellow-grey, thin, continuous, surface smooth and shiny, copiously isidiate away from the margin, corticolous and saxicolous; *isidia* concolorous with the thallus, simple, branched or becoming coralloid, narrow at the base and swelling somewhat at the tip, 0.4-1.0 mm tall, 0.25-0.5 mm diam.; *apothecia* not seen.

Chemistry: K-, KC-, C-, Pd-; 4,5-dichlorolichexanthone (minor), stictic acid (major), constictic acid (minor), skyrin (minor).

Specimen examined:
PAPUA NEW GUINEA, West New Britain, Wangowango, Willaumez Peninsula, 20 km NNE of Talasea, 5°07'S, 150°07'E, sea-level, on *Barringtonia*, *S.W. Kolema 38*, 8.xii.1984 (CBG 9311284).

Pertusaria montpittensis is characterised by the isidiate thallus, the absence of verrucae and by its chemistry. It also occurs in Norfolk Island and Queensland (where it is corticolous) and on Lord Howe Island where it is both corticolous and saxicolous (Archer & Elix 1994).

Pertusaria persulphurata Müll.Arg., *Nuovo Giorn. Bot. Ital.* **23**: 391 (1891)

Type: AUSTRALIA, Queensland, Brisbane, *F.M. Bailey s.n.*; holo: G.

Pertusaria sulphurata Müll.Arg., *Hedwigia* **32**: 125 (1893)

Type: AUSTRALIA, Queensland, Brisbane, *F.M. Bailey s.n.*, 1891; holo: G.

Thallus thick or thin, pale to bright yellow, areolate and cracked, surface smooth and dull, lacking isidia, with sparse to numerous scattered yellow soralia, saxicolous; *apothecia* absent.

Chemistry: K-, KC+orange-red, C+ orange, Pd- or Pd+ weak yellow; thiophaninic and stictic acids with or without lichexanthone. The chemistry of *P.persulphurata* was reported in detail by Elix et al. (1978).

Specimen examined:
PAPUA NEW GUINEA, National Capital Province, near Baruni Village, 9°26'S, 147°08'E, alt. 100 m, *H. Streimann 14620*, 6.ii.1981 (CBG 8113527).

Pertusaria persulphurata is characterised by the yellow, sorediate thallus, lacking verrucae and spores. It is a common saxicolous species in eastern coastal Australia and also occurs in New Zealand and Lord Howe Island.

Pertusaria plethocarpa A.W. Archer, Elix & Streimann, sp. nov. Fig.6

Thallus griseo-viridis, subrimosus, superficies subtuberculata et nitida, isidiis et sorediis destitutus; corticola; apothecia verruciformia, inconspicua, plano-hemispaerica, interdum confluentia, 0.6-1 mm diam.; ostiola inconspicua, hyalina, in verrucas singula; sporae 4nae, ellipsoideae, laeves, 90-110 μm longae, 30-37 μm latae.

Materia chemica in thallo non detecta.

Type: PAPUA NEW GUINEA, Morobe, Papua New Guinea Forestry College, Bulolo, on citrus tree in abandoned orchard, 7°10'S, 146°40'E,alt. 710 m, *J.A. Elix 12327 & H. Streimann*, 7.xii.1982; holo: CANB.

Thallus greyish green, somewhat cracked, surface subtuberculate and shiny, lacking soredia and isidia, corticolous; *apothecia* verruciform, inconspicuous, flattened hemispherical, sometimes confluent, 0.6-1 mm diam.; *ostioles* inconspicuous, translucent, 1 per verruca; *spores* 4 per ascus, ellipsoid, smooth, 90-110 μm long, 30-37 μm wide.

Chemistry: K-, KC-, C-, Pd-; no lichen compounds found.

Pertusaria plethocarpa is characterised by the four-spored asci and the absence of lichen compounds. It is known only from the type specimen.
The epithet "plethocarpa" is from the Greek, "plethos" a multitude, referring to the abundant apothecia.

Pertusaria pycnophora Nyl., *Acta Soc. Sci. Fenn.* **7**: 449 (1863).

Type: COLOMBIA, Bogota, Páramo S. Fortunata, 2800 m, *A. Lindig 870*, Jan. 1861; syntypes: H-NYL 23674, H-NYL pm 3705.

Thallus off-white, thick, areolate and cracked, surface subtuberuculate and dull, corticolous; *apothecia* disciform conspicuous, numerous, crowded, almost completely covering the thallus, 0.5-1 mm diam.; *discs* reddish brown, 0.3-0.7 mm diam., usually with off-white pruina; *spores* 8 per ascus, 1-seriate, ellipsoid, 30-47 μm long, 18-25 μm wide, spore wall 4 μm thick.

Chemistry: K-, KC+ orange-red, C+ red, P-; lecanoric acid (major) and lichexanthone (trace).

Specimen examined:
PAPUA NEW GUNEA, Simbu Province, Upper Pinnde Valley, 3 km ESE of Mount William, 5°45'S, 145°01'E, alt. 3690 m, on branch in subalpine forest, *L.K. Wade s.n.*, May 1967 (CBG 9000158).

Pertusaria pynophora is a tropical montane species characterised by asci with eight small uniseriate spores and the presence of lecanoric acid. The disciform apothecia are slightly stipitate and this feature, together with the smaller uniseriate spores, distinguish it from *P. kaindiensis* (see above).

Pertusaria rechingeri Zahlbr., *Denkschr. Math.-Naturw. Kl. K. Akad. Wiss. Wien* **88**: 24 (1911).

Type: PAPUA NEW GUINEA, Bougainville Island, near Kieta, *K. Rechinger 4607*, Sept. [1905]; holo: W.

Thallus off-white to pale yellowish-white, thin, slightly cracked, surface smooth and somewhat shiny, lacking isidia and soredia, corticolous; *apothecia* verruciform, flattened hemispherical, conspicuous, numerous, sometimes confluent, not constricted at the base, 0.8-1.5 mm diam.; *ostioles* black, conspicuous, 2-3 per verruca, punctiform superficially appearing as 1; *spores* 4 per ascus, ellipsoid, smooth, 1-seriate, 95-120 μm long, 35-45 μm wide.

Chemistry: K-, KC-, C-, P-; thiophaninic acid (minor), 4-chloro-6-*O*-methylnorlichexanthone (minor), lichexanthone (minor) and 2'-*O*-methylperlatolic acid (major).

Pertusaria rechingeri is characterised by the four-spored asci and its chemistry; it is known only from the type specimen.

Pertusaria scaberula A.W. Archer, *Mycotaxon* **41**: 240 (1991).

Type: AUSTRALIA, New South Wales, Springwood, Sassafras Creek, 65 km W of Sydney, 33°43'S, 150°34'E, alt. 250 m, *A.Archer P 8*, 16.vii.1988; holo: NSW.

Thallus off-white to greyish white, thin, areolate and cracked, surface smooth, sorediate, lacking isidia, corticolous; *soralia* white, conspicuous, becoming numerous away from the margin, flattened and disciform, 0.5-1.5 mm wide; *apothecia* not seen.

Chemistry: K+ yellow, KC-, C-, P+ yellow; thamnolic acid ± lichexanthone [lichexanthone uncommon in Papua New Guinea specimens].

Specimens examined:
PAPUA NEW GUINEA, Morobe Province, Heads Hump, 6 km SE of Bulolo, 7°13'S, 146°42'E, alt. 1000 m, on rotting tree trunk, *H. Streimann 17394*, 7.iii.1982 (B, CBG 8201521, LAE); New Britain, Laliti Mountain, Nakanai Mountains, 40 km SE of Hoskins, 5°42'S, 150°41'E, alt. 240 m, on *Palaquium*, *H. Streimann 41186*, 21.ii.1989 (B, CBG 8911995); *ibid*., on *Homalium foetidum*, *H. Streimann 41274*, (B, CBG 8912082)[with lichexanthone]; New Britain, Soi River, 23 km SW of Mt. Ulawun, 5°08'S, 150°09'E, alt. 30 m, on *Palaquium*, *H. Streimann 41502*, 27.ii.1989 (B, CBG 8912307).

Pertusaria scaberula somewhat resembles the saxicolous *P. subventosa* Malme but is distinguised from that species by the absence of picrolichenic acid. It is common in south-eastern coastal Australia where it always contains lichexanthone whereas in Papua New Guinea it usually contains thamnolic acid alone.

Pertusaria subventosa Malme var. **hypothamnolica** A.W. Archer & Elix, *Mycotaxon* **49**: 146 (1992).

Type: AUSTRALIA, Queensland, between Breakneck and Quandong Creeks, 24 km WSW of Proserpine, 20°29'S, 148°22'E, alt 150 m, on basalt rocks, *J.A. Elix 21160*, 2.vii.1986; holo: ANUC.

Thallus of-white to greyish-white, moderately thick, areolate and cracked, surface smooth and sorediate, lacking isidia, saxicolous; *soralia* white, conspicuous, becoming numerous away from the margin, sometimes becoming slightly stipitate; *apothecia* not seen.

Chemistry: K+ violet, KC+ violet, C-, P-; lichexanthone, picrolichenic and hypothamnolic acids.

Specimen examined:
PAPUA NEW GUINEA, Central Province, Varirata National Park, Sogeri, 22 km ENE of Port Moresby, 9°25'S, 147°21'E, alt. 600 m, *H. Streimann 14453*, 5.ii.1981 (CBG 8113359).

Pertusaria subventosa var. *hypothamnolica* is a conspicuous, white, saxicolous lichen which also occurs in eastern Queensland, Australia. It is distinguished from the somewhat similar sterile saxicolous species, *P. amaroides* Magn. (Magnusson 1950) from Uruguay and Argentina, by the presence of picrolichenic acid; *Pertusaria amaroides* [syn. *P. amara* var. *tucumanensis* Räs. (Räsänen 1948)] contains only lichexanthone and hypothamnolic acid.

Pertusaria thwaitesii Müll.Arg., *Flora* **67**: 470 (1884).

Type: CEYLON [Sri Lanka], Peradeniya, *G. Thwaites s.n.*, 1876; holo: G.

Pertusaria wilsonii A.W. Archer, *Mycotaxon* **41**: 250 (1991).

Type: AUSTRALIA, Queensland, Clarke Range, 46 km S of Proserpine, *J. A. Elix 20943* ; holo: ANUC.

Thallus off-white to pale grey, wrinkled, cracked and areolate, surface dull, lacking isidia and soredia, corticolous; *apothecia* verruciform, conspicuous, concolorous with the thallus, numerous, very flattened hemispherical or irregular in outline, 1-2 mm wide; *ostioles* numerous, conspicuous, pale becoming black, punctiform , becoming somewhat sunken, 3-8, sometimes to15 per verruca; *spores* 2 per ascus, uniseriate, elongate-ellipsoid, rough, 110-160, rarely to 175 μm long, 35-50 μm wide.

Chemistry: K-, KC-, C-, Pd+ orange-red; protocetraric acid (major), lichexanthone (trace), virensic acid (trace).

Specimen examined:
PAPUA NEW GUINEA, Morobe Province, Heads Hump, 4 km SE of Bulolo, 7°13'S, 146°14'E, alt. 780 m, *J.A. Elix 11896 & H. Streimann*, 3.xii.1982 (ANUC).

Pertusaria thwaitesii is characterised by the conspicuous flattened verrucae with numerous black ostioles, asci with two rough spores and the presence of protocetraric acid.
The species also occurs in Sri Lanka and eastern Australia, from Queensland to as far south as Victoria (Mallacoota), predominantly near the coast.

Pertusaria velata (Turner) Nyl., *Lich.Scand.*: 179 (1861)

Parmelia velata Turner, *Trans. Linn. Soc. London* **9**: 143 (1808)
Type: ENGLAND, Sussex, on ash trees, 1805, *W.Borrer*; holo: BM

Thallus greyish white to off-white,thick, slightly cracked and areolate, surface smooth to slightly wrinkled, dull, lacking isidia and soredia, corticolous; *apothecia* disciform, numerous, crowded, immature apothecia irregularly hemispherical or subspherical, constricted at the base, 0.5-1 mm diam., mature apothecia becoming flatened and exposing pale to dark reddish orange discs, 0.5-0.8 mm diam., slightly or densely white-pruinose; *spores* one per ascus, smooth, ellipsoid, thin-walled, 110-150, rarely to 175 μm long, 30-45 μm wide.

Chemistry: K-, KC+ orange red, C+ red, Pd-; lecanoric acid (major) ± lichexanthone (trace).

Selected specimens examined (6 out of 13):
PAPUA NEW GUINEA, Central Province, Narirogi Creek, on Varivata National Park Road, 27 km ENE of Port Moresby, 9°25'S, 147°24'E, alt. 440 m, *H. Streimann 15084*, 11.ii.1981 (CBG 8115116); Eastern Highlands Province, Waiopa, Aiyura-Omaura Road, 13 km SE of Kainantu, 6°22'S, 145°58'E, alt. 1450 m, on rotten log, *J.A. Elix 12439 & H. Streimann*, 8.xii.1982 (ANUC); Eastern Highlands, Pusarasa Village, 2 km

N of Okapa, 6°30'S, 145°36'E, alt. 1720 m, *J.A. Elix 12570 & H. Streimann*, 9.xii.1983 (ANUC); Southern Highlands, Tari-Komo Road, 6 km N of Komo, 6°01'S, 142°51'E, alt. 1480 m, *J.A.Elix 13247 & H. Streimann*, 16.xii.1983 (ANUC); Eastern Highlands, Wopeia, Aiyura-Omara Road, 10 km S of Aiyura, 6°20'S, 145°55'E, alt. 1550 m, *H. Streimann 18336*, 10.iv.1982 (CBG 8204116); Morobe Province, Heads Hump, 4 km ESE of Bulolo, 7°13'S, 146°40'E, alt. 900 m, *H. Streimann 17834*, 7.iii.1982 (CBG 8202623).

Pertusaria velata is a widely distributed species found in temperate, subtropical and tropical areas. It is characterised by asci with one spore and the presence of lecanoric acid.

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KEY TO THE *PERTUSARIA* OF PAPUA NEW GUINEA

1. Corticolous (including lichenicolous) species..2
1a. Saxicolous species...21

2. Sterile, sorediate or isidiate...3
2a. Fertile , apothecia disciform or verruciform...6

3. Thallus sorediate...4
3a. Thallus isidiate, with 4,5-dichlorolichexanthone and stictic acid.....*P. montpittensis*

4. Soralia K+ yellow or violet...5
4a. Soralia K-ve, KC+ violet, picrolichenic acid............................*P. buloloensis*

5. Soralia K+ yellow, Pd+ yellow, thamnolic acid............................*P. scaberula*
5a. Soralia K+ violet, Pd-ve, hypothamnolic acid......................*P. hypothamnolica*

6. Apothecia disciform...7
6a. Apothecia verruciform..12

7. Spores 1 per ascus..8
7a. Spores 8 per ascus..9

8. Discs K+ violet, C-ve, hypothamnolic acid; spores 140-190 µm long.................
....*P. hypothamnolica*
8a. Discs K-ve, C+ red, lecanoric acid; spores 110-150 µm long................*P. velata*

9. Discs K+ yellow, KC-ve, thamnolic acid; spores 30-50 µm long, 2-seriate.............
....*P.epitheciifera*
9a. Discs K-ve, KC+ red or KC-ve...10

10. Discs KC-ve, no lichen compounds; spores 45-50 µm long............*P. gyalectoides*
10a. Discs KC+red, lecanoric acid..11

11. Spores 30-47 µm long, 1-seriate..*P. pycnophora*
11a. Spores 58-75 µm long, 2-seriate...*P. kaindiensis*

12. Spores 2 or 4 per ascus..13
12a. Spores 8 per ascus...20

13. Spores 2 per ascus...14
13a. Spores 4 per ascus...16

14. Spore walls smooth, spores 80-105(-120) μm long.......................*P. damiensis*
14a. Spore walls rough, spores usually >110 μm long...................................15

15. Ostioles numerous, conspicuous; spores 110-160 μm long; verrucae Pd+ orange-red protocetraric acid...*P. thwaitesii*
15a. Ostioles inconspicuous; spores 110-125 μm long; verrucae Pd- , stictic acid..*P. cicatricosa* var. *deficiens*

16. Spores wall rough, spores 80-120(135) μm long.......................*P. microstoma*
16a. Spore walls smooth...17

17. Ostioles translucent; spores 90-110 μm long; lichen compounds absent...*P.plethocarpa*
17a. Ostioles black; lichen compounds present..18

18. Thiophaninic acid present; spores 95-120 μm long.......................*P. rechingeri*
18a. Thiophaninic acid absent...19

19. Lichexanthone present with stictic and higher perlatolic acids..............*P.modesta*
19a. Lichexanthone absent, chlorinated xanthones and stictic acid............*P. ceylonica*

20 (12a).Spores 105-135 μm long, spore walls rough...................*P. anomalospora*
20a. Spores 60-80 μm long, spore walls smooth.......................... *P. leiocarpella*

21. Thallus yellow; UV+ orange; KC+ orange............................*P. persulphurata*
21a. Thallus white; UV+ yellow; KC+ violet........*P. subventosa* var. *hypothamnolica*

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A REVISED KEY TO THE GENUS *SCLERODERMA*

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SUMMARY

Twenty-five species of *Scleroderma* have been recognised. The revised key is based mainly on spore characters determined at the light microscope level. *Scleroderma* species are assigned to one of three sections based on whether the spores are spiny, sub-reticulate or reticulate.

INTRODUCTION

The Sclerodermatales are widespread and common, either as saprotrophs in soil or on rotting wood, or as ectomycorrhizal symbionts of several important orders of trees (Hawksworth *et al.*, 1983). The Sclerodermatales includes four well defined families: Sclerodermataceae, Astreaceae, Broomeiaceae and Pisolithaceae. A fifth family may have to be constructed for the recently described hypogeous member of the genus *Horakiella, H.clelandii* Castellano and Trappe (1992). Until new material in all stages of development has been examined it cannot with conviction be placed in any of the families above. It differs from *Scleroderma* species in its hypogeous growth habit and its large (25-30 x 30-35µm), irregularly shaped spores. The Astreaceae are distinguished by the fact that the exoperidium splits at maturity to form an 'earth star', whilst in other families the exoperidium does not split, or if it does it exposes the naked gleba (Miller and Miller, 1988). The Broomeiaceae (Zeller, 1948) differs from the Sclerodermataceae and Pisolithaceae in that there are numerous spore sacs seated on a common stroma. The Pisolithaceae is separated from the Sclerodermataceae by the fact that the gleba is divided up into a large number of persistant, thick-walled peridioles. By far the largest of the families is the Sclerodermataceae, and at least twenty-five species have been described. The other families contain very few species e.g. the Pisolithaceae contains only two (Watling *et al.*, 1994). Their basidiomes are frequently found within both established forests and disturbed sites and in some cases these can be traced back to their ectomycorrhizae, but in other cases their ectomycorrhizal status is unknown. Although the related *Pisolithus arhizus* (Pers.) Raus. is the most widely used fungus for inocula to improve the establishment of forest tree seedlings (Ruehle, 1980; Marx *et al.*, 1979), and is easily identified from basidiomes in the field, *Scleroderma* basidiomes are more difficult to identify. Indeed a comprehensive key to the species is not available. Several *Scleroderma* isolates are currently being used as ectomycorrhizal inoculum, especially in tropical ecosystems (Marx *et al.*,1991) and these have frequently not be assigned to particular species. During an investigation of the ectomycorrhizal associates of S.E. Asian trees, we have collected many sclerodermataceous fungi, and found it necessary to revise and consolidate the available literature into a revised key to world species. From the material studied it was clear that spore morphology fell into three well defined types; spiny, sub-reticulate or reticulate spores. Twenty-five species of *Scleroderma* have been distinguished. The key has been constructed as a necessity to assist in a systematic survey of the Sclerodermataceae in the Philippines, and has since been successfully used in the field to identify various *Scleroderma* species in a variety of S.E.Asia collections.

METHODS AND MATERIALS

Dried herbarium material was studied using a Leitz Diaplan light microscope. Slides were prepared by mounting a smear of spores in a drop of absolute alcohol and a drop of 10% ammonium hydroxide. Spore ornamentation was observed using an oil immersion (x100) objective. Spore size was determined by measuring the diameters of at least thirty spores including the ornamentation and calculating the mean. Mature spores only were chosen for measurement, because of the great variation found as the spores develop. Spines and other ornamentation are formed with the help of the 'nurse cells' (Castellano and Trappe, 1992). Such variation is also found between mature and immature spores of *Strobilomyces*, but in a totally different way viz. without the help of the 'nurse cells'. Uncannily, the range of spore morphologies found in *Strobilomyces* is very similar to that of *Scleroderma*, which they superficially resemble. Other characters such as thickness of the peridium, glebal colour and external peridium characters were observed using a x10 hand lens. All drawings were made with the aid of a Sony PA50 video printer attached to a microscope, rather than from photographic prints. Scanning electron microscopy was carried out using air-dried, sputter -coated spores mounted on conventional S.E.M. stubs, using a Philips 525M S.E.M.

RESULTS

Examination of a wide range of specimens confirmed Guzmán's (1970) observation that spore morphology fell into three morphotypes: spiny, sub-reticulate or reticulate. Within those with spiny spores there are two distinctive groups; those with echinulate spines and those with verrucose spines. All species can be easily assigned to one of these four categories and typical examples of each are illustrated (Figs. 1-4). The light microscope observations are confirmed by scanning electron microscopy (Figs. 5-8). More detailed examination of spore characteristics has enabled the separation of individual species within these categories and a new key is reproduced below.

It is also worth noting that although mature basidiomes of *Pisolithus* can be distinguished from mature basidiomes of *Scleroderma* by the distinct peridioles, it can be difficult to separate out young *Scleroderma* from *Pisolithus*. In *Scleroderma*, gleba are white when young, and composed of minute fragile walled peridioles which break down at an early stage to produce a purple-brown or chocolate-brown, but frequently olivaceous tinted, powdery mass, leaving no traces of the peridioles. In *Pisolithus*, gleba are composed of brown, persistent, thick-walled peridioles which develop in sequence downwards and always leave some peridioles at the base of an olivaceous yellow to brown powdery mass. This emphasises the need to examine collections of specimens of mixed age.

KEY TO THE WORLD SPECIES OF THE SCLERODERMATACEAE

1a	Basidiospores echinulate or verrucose, never reticulate, with rare interconnections joining spines, hyphae without clamp-connections. **Section *Aculeatispora***	**3**
1b	Spores subreticulate or reticulate, hyphae with clamp-connections.	**2**
2a	Spores catenulate-reticulate with wings joining the spines. **Section *Sclerangium***	**13**
2b	Spores with a complete reticulum. **Section *Scleroderma***	**20**

Section *Aculeatispora*

3a	Peridium covered in persistent velvety veil. Basidiome with distinctive stipe.	**4**
3b	Peridium not as above. If basidiome with stipe then this composed of compacted rhizomorphs.	**5**
4a	Spores 8-10µm.	**1 *S.leptopodium*** (Fig.9)
4b	Spores 10-12µm.	**2 *S.columnare*** (Fig.10)
5a	Peridium thin <1mm when dry.	**6**
5b	Peridium thick >1mm when dry.	**11**
6a	Spores with sharp, narrow spines.	**7**
6b	Spores with blunt, conical spines.	**8**
7a	Spores 8-13µm, with spines <1µm long. Peridium covered in small scales.	**3 *S.verrucosum*** *1 (Fig.11, see note 1)

7b	Spores 11-15µm, with long narrow spines <2µm long. Peridium surface areolate.	**4 *S.areolatum*** (Fig.12)
8a	Basidiome small in size, 2-5mm, peridium distinctively eye-blue to mouse-grey.	**5 *Scleroderma* sp.1** (Fig.13, see note 2)
8b	Basidiome >5mm, peridium lacking blue colour.	**9**
9a	Peridium covered in small scales. Spores 8-13µm, with spines <1µm long.	**6 *S.verrucosum* *2** (Fig.14, see note 1)
9b	Peridium mainly smooth at most slightly scaly. Spores in range 9-16µm .	**10**
10a	Spores 11-16µm, blunt spines densely distributed. Peridium smooth to slightly scaly, very scaly on drying when immature.	**7 *S.albidum*** (Fig.15)
10b	Spores 9-14µm,blunt spines sparsely distributed. Peridium smooth, usually coarsely cracked near base.	**8 *S.laeve*** (Fig.16)
11a	Spores 10-13µm covered in small verrucose warts. Peridium mainly smooth with a few pits near the top of basidiome.	**9 *S.uruguayense*** (Fig.17, see note 3)
11b	Spores 8-12µm with narrow spines. Peridium roughened to some degree.	**12**
12a	Peridium scaly to coarsely cracked. Gleba mouse-grey.	**10 *S.cepa*** (Fig.18, see note 4)
12b	Peridium squarrose. Gleba distinctive fuscous black.	**11 *S.texense*** (Fig.19, see note 5)

Section *Sclerangium*

13a	Peridium thin <1mm when dry.	**14**
13b	Peridium thick >1mm when dry.	**16**
14a	Spores large, 13-17µm, covered in long spines 1.5-4.2µm long	**12 *S.chevalieri*** (see note 6)

14b	Spores small, 5-8µm with spines <1µm long.	**15**
15a	Spores distinctly ornamented. Peridium coloured lemon-yellow to chrome-yellow often with dark brown/ black scales on surface. Frequently with second thinner, inner orange-red peridium.	**13 *S.sinnamarense*** (Fig.20)
15b	Spores appearing almost smooth and angular, although ornamentation is catenulate reticulate. Peridium distinctive straw-colour and smooth.	**14 *S.stellatum*** (Fig.21)
16a	Peridium mainly smooth, or at most slightly scaly or finely cracked.	**17**
16b	Peridium with pyramidal spines, covered in many scales and cracking.	**18**
17a	Peridium smooth to slightly scaly, dehiscence frequently stellate. Spores 10-14µm.	**15 *S.polyrhizum*** (Fig.22)
17b	Peridium smooth to finely cracked, dehiscence irregular not stellate. Spores 11-16.5µm.	**16 *S.reae*** (Fig.23)
18a	Peridium covered in pyramidal, conical spines. Basidiome often reddish in colour. Spores 6.5-8µm with long spines ≤2.5µm long.	**17 *S.echinatum*** (Fig.24)
18b	Peridium covered in many scales and cracks. Basidiome often pale or dull in colour. Spores >8µm with spines <1µm.	**19**
19a	Peridium <2mm thick, covered in regular scales and cracks arranged in rosette near the top of the basidiome. Stipe-like base lacking. Spores often have a well-defined reticulum, 11-14µm.	**18 *S.citrinum*** (B) (Fig.25, see note 7)
19b	Peridium <3mm thick, covered in irregular scales and cracks. Large stipe-like base approximately half the length of the basidiome. Spores 9-12µm with less well-defined reticulum.	**19 *S.floridanum*** (Fig.26)

Section *Scleroderma*

20a	Peridium thick >1mm when dry.	**21**
20b	Peridium thin <1mm when dry.	**22**
21a	Spores 11-14µm, peridium covered in scales and cracks, with scales arranged in rosette near the top of basidiome.	**20 *S.citrinum*** (A) (Fig.27, see note 7)
21b	Spores 14-20µm, peridium covered in individual raised and separated scales which are often darkly coloured.	**21 *S.michiganense*** (Fig.28)
22a	Spores with spines >1µm long.	**23**
22b	Spores with spines <1µm long.	**24**
23a	Spores 11-17µm with very dense reticulum. Peridium smooth to slightly scaly or cracked, stipe lacking.	**22 *S.fuscum*** (Fig.29)
23b	Spores 10-13µm with more open reticulum. Peridium peppered with small black scales, stipe present.	**23 *S.dictyosporum*** (Fig.30)
24a	Spores large 17-20µm.	**24 *S.hypogeum*** (Fig.32)
24b	Spores <16µm.	**25**
25a	Rhizomorphic foot approximately half the length of the basidiome. Spores 11-15µm.	**25 *S.meridionale*** (Fig.33, see note 8)
25b	Rhizomorphic foot absent .	**26**
26a	Basidiome +/- sessile. Spores 11-16µm. Peridium brittle, smooth or covered in fine, small scales.	**26 *S.bovista*** (Fig.34)
26b	Basidiome sessile. Spores 10-13µm. Peridium golden-yellow covered with snuff-brown, pyrimidal warts.	**27 *Scleroderma* sp.2** (Fig.35, see note 2)

NOTES FOR THE *SCLERODERMA* KEY

Note One *S.verrucosum*

The distinctive verrucose nature of the peridium has resulted in many specimens being placed in this taxon. From the material studied, however, there are two types of spore ornamentation exhibited, viz. sharp narrow spines and blunt conical spines. As a consequence, this species is keyed out in two positions of this key. More detailed studies on a range of specimens will probably reveal that two autonomous species are included.

Note Two *Scleroderma* sp.1 and *Scleroderma* sp.2

These two entries refer to two new species from Malaysia. They will be described as new species in a forthcoming publication (Sims and Watling, unpublished).

Note Three *S.uruguayense*

The type material authenticated by Guzmán has echinulate spores, yet the original description (Guzmán, 1970) specified reticulate spores. We have placed *S.uruguayense* in the ***Aculeatispora*** in accordance with the type material.

Note Four *S.cepa*

Guzmán (1970) considers the North American *S.flavidum* a synonym of *S.cepa*. Coccia *et al.*, (1990) separated *S.flavidum* by "a peridium with two microscopically distinguished layers, the internal layer made up of large hyphae". Now this distinction has been demonstrated, more detailed studies are required on a range of material.

Note Five *S.texense*

The spores of the type material are echinulate, whereas Guzmán (1970) described them as sub-reticulate. The original description of this taxon (Berkeley, 1845) indicates that the spores are "globose, granulated", i.e. covered with small particles or little grains. This description fits the characteristics we found in the type specimen, therefore this species falls within the ***Aculeatispora***.

Note Six *S.chevalieri*

We have not been able to obtain type material of this species, but Guzmán (1970) described the spores as sub-reticulate with long spines. We have therefore placed it in the section ***Sclerangium***.

Note Seven *S.citrinum*

The spore ornamentation of this species seems to vary greatly between sub-reticulate or catenulate spores, to mildly or strongly reticulate spores. There would appear to be a continuum of variation, and does not merit establishing different species.

Note Eight *S.meridionale*

Demoulin and Malençon described this species in 1971, although it probably includes *S.macrorrhizon* of Wallroth (1833). Since there is no type material for the latter,and the description is inadequate by modern standards, it is impossible to use with conviction Wallroth's species. Demoulin and Malençon believe that *S.macrorrhizon sensu* Guzmán is a synonym of *S.meridionale*.

MATERIAL STUDIED

Unless otherwise stated all material is in the herbarium at the Royal Botanic Garden Edinburgh (E).

1 *S.leptopodium* Har. & Pat.

S.E.Asia

Indonesia: Kalimantan, Waraniset, 24 Sept. 1992, legit P.Jeffries, Wat 24992; Cikarawang, Jan. 1994, P.Jeffries, Nos. 3-8. Philippines: Zambales, 22&23 June 1993, K.Sims, K32&K33. Singapore: Bubit Tumili, 22 Sept. 1929, E.J.H.Corner, Malay Peninsula (1).

2 *S.columnare* Berk. & Br.

Australia

Herb. Dr.A.Morrison, no further notes.

India

Bhutan, Chukka district, E. facing slopes above Chukka Dzong, 24 Feb. 1982, D.G.Long, 10481.

S.E.Asia

Borneo: Kinabalu, Mesilau, 26 Jan. 1964, E.J.H.Corner, RSNB 5145; *ibid* 5000 feet 21 January 1964, E.J.H.Corner; *ibid* 7 March 1964, E.J.H.Corner, RSNB 5145A. Indonesia: Cikarawang, Summer 1991, P.Jeffries, 31 & 33; W.Java, Haurbantas, Summer 1991, P.Jeffries, 1-4, 51 & 74. Malaysia: Kepong, FRIM, 25 Feb. 1994, R.Watling, Wat 25658; Pahang, 9 June 1931, E.J.H.Corner. Philippines: Baguio, 27 June 1992, legit P.Jeffries, Wat 25012; Zambales, 22 June 1993, K.Sims, K18; Zambales, 23 June 1993, K.Sims, K19-K25. Singapore: Jungle Botanic Gardens, 14 Sept. 1929, E.J.H.Corner, Malay Peninsula (2); *ibid* Oct. 1930, E.J.H.Corner, Malay Peninsula (2).

3 & 6 *S.verrucosum* Pers.

Australia

A.C.T.: Tidbinbilla Nature Reserve, 26 April 1974, R.Watling, Wat 10680. N.S.W.: Moonan, Mueller, no further notes; near Preston, 25 June 1885, Dr.A.Morrison; Sydney, near Loftus, Royal New Park, 10 April 1974, R.Watling, Wat 10991; north of Sydney, Ku-ring-gai Chase National Park, 14 April 1974, R.Watling, Wat 10868. Victoria: Daylesford, R.Wallace, no further notes; Melbourne, Brooke, Port Phillip, Herb. F.von Mueller; Melbourne, Dec 1885, F.Reader; near Melbourne, F.Reader, no further notes; Mount Cole, Victoria Mill, 29 April 1982, R.Watling, Wat 14734.
Herb. Dr.A.Morrison, no further notes.

Europe

UK,England: Aborcarn Park, 2087/118, Herb. Greville; Yorkshire, Halifax, Stoney Royd Cemetry, 10 Sept 1956, R.Watling, Wat 426(1); Yorkshire, near Appleton, 27 Sept.1971, R.Watling, Wat 8892 & legit J.Evitt, Wat 8937. Scotland: Drum, Blackdub Wood, 8 Oct 1983, legit N.Stewart & H.Stace, Wat 17576; Loch Lomond, Rossdhu, 11 Sept 1959, J.T.Palmer; Midlothian, Corstorphine Hill, 12 Nov 1967, R.Watling, Wat 5334; Midlothian, Pincuitland, 7 Oct 1954, D.M.Henderson, 1711.

S.E.Asia

Malaysia: Kepong, FRIM, 11 Mar 1992, legit A.Taylor, Wat 24872; Kepong, FRIM, 19 Mar 1993, E.Turnbull, ET26; Surgui Valley, Ulu Lungat, 4 Mar 1992, R.Watling, Wat 24826; Pahang, Cameron Highlands, 31 July 1934, E.J.H.Corner, Malay Peninsula (4). Philippines: UPLB, Biotech, 3 April 1992, legit P.Jeffries, Wat 25174; Makiling, 23 June 1992, legit P.Jeffries, Wat 24983-24986; Benguet, 17 June 1993, K.Sims, K37; Biotech, 15 June 1993, K.Sims, K38-K40; Makiling, 21 June 1993, Mycorrhiza Lab. Staff, K41 & K42; Zambales, 22 June 1993, K.Sims, K43; Makiling, 30 June 1993, K.Sims, K44-K46. Singapore: 11 Aug 1992, Dr T.K.Tai, Wat 24632. Solomon Islands: Kolombangara, 4 Sept. 1965, E.J.H.Corner, RSS 1267.

North America

Florida: Seminole, 7 Dec. 1957, P.O.Schallent, F499. Idaho: Kootenai Co. Post Falls, 21 Sept. 1966, legit K. Scates, Wat 3366. Michigan: Livingston Co. George Reserve, 4 Sept. 1965, R.Homola, 1425A/792.

T.Kirk, 350, no further notes.

Sept 1824, Bellovaco, no further notes.

4 *S.areolatum* Ehrenb.

Africa

Cameroun: S.W. Province, Mundemba, Korup Forest Reserve, 29 Mar. 1991, R.Watling & I.Alexander, Wat 22912.

Australia

N.S.W.: Clarence River; Herb.M.C.Cooke 1885. Tasmania: North Gipps Sand, H.Tidale, no further notes. Victoria: Melbourne, Studley Park, 18 May 1887, Herb. Dr.A.Morrison. W.A.: Cannington, Lower Cannington River, 23 Aug. 1901, Dr.A.Morrison.

Europe

UK,England: Hampstead, Sept. 1863, Herb.M.C.Cooke 1885; New Forest, Sept. 1992, legit R.Collings, K5; Sussex, Kirkford, The Men's, Hammond Wood, 23 Sept. 1973, R.Watling, Wat 9738; West Sussex, Ambersham Common, 24 July 1993, T.V.Sims & K.Sims, K9; West Sussex, Graffham Common, 24 July 1993, T.V.Sims & K.Sims, K11.

New Zealand

Wellington: Kirk; no.41, no further notes.

North America

Maine: Westbrook, E.G.Bolles, no further notes. Michigan: Livingston Co. Picrol Lake, 18 Sept. 1965, S.Mazzar, 1441A/797; University of Michigan Biological Station, 19 Aug. 1965, R.Watling, 755/1271A. Oregon: Benten Co. Bak. Cr., 29 July 1974, legit R.Ames, Trappe 3985. St.Louis: legit Jealease, no.2, no further notes.

Legit Ehrenberg, Herb. Nees von Esenbeck, no further notes.

5 *Scleroderma* sp.1

S.E.Asia
Singapore: April 1941, E.J.H.Corner, Malay Peninsula (9).

7 ***S.albidum*** Pat. & Trab.

Australia
ACT: Tidbinbilla Nature Reserve, 27 April 1974, R.Watling, Wat 10653. W.A.: Greenmount, Darling Range, 24 Aug 1897, Dr.A.Morrison; Perth Park, 21 July 1899, Dr.A.Morrison, 68d.
Central America
Mexico: Naucalpan, 20 Sept. 1967, M.L.Arreguin, no.24, (MICH).

8 ***S.laeve*** Lloyd

Australia
N.S.W.: Moonan, legit Miss Taster, Herb.M.C.Cooke 1885. Victoria: Creswick, Armstrong Road, 30 April 1982, R.Watling, Wat 14722; near Preston, 25 July 1885, Herb. Dr.A.Morrison; Oakleigh, 5 July 1889, Herb. Dr.A.Morrison.
North America
Oregon: Eugene, University of Oregon, 18 Sept. 1938,legit M.Doty, 477, (NY).

9 ***S.uruguayense*** Guzmán

South America
Uruguay: Maldonado, Punta Ballena, 12 June 1947, W.G.Herter; Herb. Hert. 61485, (Iso-NY).

10 ***S.cepa*** Pers.

Australia
W.A.: Bulberry area, Pemberton Bainis property, 14 May 1974, R.Watling, Wat 10210; Bulberry area, Pemberton, Allis-Power Road, 15 May 1974, R.Watling, Wat 10194. Victoria: Melbourne, Studley Park, July 1889, Herb. Dr.A.Morrison; Snowy River, 1891, Cameron, no further notes.
India
Dehra Dun, New Forest, 4 Sept. 1977, I.Alexander, IA12.
S.E.Asia
Philippines: Mindanao, 1993, E.Lorilla, 93-P13.
Europe
UK,Scotland: Penicuik, 1870, Herb. W.Evans 1981. Germany: Lusatia, Brandenberg, Aug. 1845, legit Kritrihmar, Herb. Cooke.

11 *S.texense* Berk.

North America
Texas: legit Mr Drummond, (Holo-K).

12 *S.chevalieri* Guzmán

No material studied.

13 *S.sinnamarense* Mont.

Pacific Islands
Fiji: Suva Fiji, Suva, Rudi Highway, 1993, legit J.Hedger, Wat 25139.
S.E.Asia
Borneo: Kinabalu, Mesilau, 5000 feet, 21 Jan. 1964, E.J.H.Corner. Malaysia: Kepong, FRIM, 30 Aug. 1991, L.Su-See, 618; *ibid* 17 Mar. 1992, legit A.Taylor, Wat 24849; *ibid* 16 Mar. 1993, E.Turnbull, ET1; *ibid* 23 Mar. 1993, E.Turnbull, ET61; *ibid* 29 Feb. 1992, R.Watling, Wat 24844; near Kuala Lumpur, Kepong, 5 April 1993, legit N.Sikin, Wat 25188; Pasoh, 17 Mar. 1992, R.Watling, Wat 24825; Rovers Trail, 10 Mar. 1992, R.Watling, Wat 24827; Selangor, legit L.Su-See 55.617, Wat 25190; Johore, Yunong Panti, April 1931, E.J.H.Corner; 1941, E.J.H.Corner, Malay Peninsula (3a), no further notes. New Guinea: Herb.M.C.Cooke 1885, no further notes. Philippines: Zambales, 22 June 1993, K.Sims,K34 & K35; *ibid* 23 June 1993, K.Sims, K36. Sarawak: Siduk, Baram District, Gunong Mulu National Park 4th Division, 17 Nov. 1977, G.Argent, 786. Singapore: Jungle Botanic Gardens, Sept. 1929, E.J.H.Corner, Malay Peninsula (3). Solomon Islands: San Cristobal, east of Warahito River, 3 Aug. 1965, E.J.H.Corner, RSS 951; San Cristobal, Huni River, 11 Aug. 1965, E.J.H.Corner, RSS 992.

14 *S.stellatum* Berk.

S.E.Asia
Borneo: Kinabalu, Mesilau, 4500 feet, 27 April 1964, E.J.H.Corner, RSNB 8476. Malaysia: Johore, 11 May 1941, E.J.H.Corner, Malay Peninsula (10); 23 Sept. 1940, E.J.H.Corner, Malay Peninsula (10); 16 April 1931, E.J.H.Corner, Malay Peninsula (10); Johore, Yunong Panti, on a ridge, April 1930, E.J.H.Corner; Pahang, Fraser's Hill, 29 Nov. 1930, E.J.H.Corner; *ibid* May 1930, E.J.H.Corner. Solomon Islands: San Cristobal, Warahito River, 1 Aug. 1965, E.J.H.Corner, RSS 904; Ysabel, Cockatoo, Andorage, 24 Sept. 1965, E.J.H.Corner.
South America
Venezuela: Panuré, legit Berkeley, (Holo-K).

15 *S.polyrhizum* Pers.

Europe
France: Corse, near Port de Chiavari, 14 Oct. 1972, legit V.Demoulin, 4553, (K).

North America

California: San Diego Co. Wilderness Gardens Reserve, 13 Mar. 1981, O.K.Miller & R.Watling, Wat 17261; Massachusetts: Falmouth, Racing Beach, Dec. 1934, legit Miss Whittemore, (NY); Michigan: Talison Co. Wanna Wanna Lake, 2 Sept. 1965, A.H.Smith, 810/1519A.

16 *S.reae* Guzmán

North America

California: Santa Barbara Co. Santa Barbara, Mission Canyon Road, P.M.Rea, Rea Herb. 205, (Holo-MICH).

17 *S.echinatum* (Petri) Guzmán

S.E.Asia

Borneo: Kinabalu, Liwagu River, 4000 feet, 2 Sept. 1961, E.J.H.Corner, RSNB 2681. Malaysia: Negri Sembilah, Pasoh, 17 Mar. 1993, R.Watling, Wat 24824 & 24862; Kelantan, S.Ketil, 31 May 1931, E.J.H.Corner; Negri Sembilah, Yunong Angx, 4 July 1930, E.J.H.Corner; 9 Sept. 1934, E.J.H.Corner, Malay Peninsula (5); 5 May 1940, E.J.H.Corner, Malay Peninsula (5a). Solomon Islands: Kolombangara, 23 Aug. 1965, E.J.H.Corner, RSS 1027.

18 & 20 *S.citrinum* Pers.

Europe

Czechoslovakia: Prencöw, Fungi Schemnitzienses, June 1890, A.Kmet. Finland: Vuorentaka, Halliko, near Turku, 25 Aug. 1971, R.Watling, Wat 8342. Germany: Berlin Park, 25 July 1888, W.Nagimms; Lusatia, Brandenberg, Aug. 1845, C.F.Kritrihmar, Herb. Cooke; *ibid* Herb. Evans (1981); Am Rande eines trockenen Grabens im Walde bei Sundische Wiese bei Zingst, 22 Aug. 1912, P.Sydow, 1059. UK, England: Essex, Loughton,1882, no further notes; Farnley Tyas, 17 Oct. 1954, Wat 353(2); Hampstead, 1870, Herb.M.C.Cooke 1885, no.'s 417(1) & 417(2); Hampstead, Sept. 1863, Herb.M.C.Cooke 1885; Hardcastle Craggs, 9 Oct. 1954, R.Watling, Wat 353(1); New Forest, Sept. 1992, legit G.C.Dickson, K3; Norwich, Mousehold, 3 Nov. 1916, W.Evans; Roydon Woods Nature Reserve, Woodhouse Plantation, 31 Oct. 1992, legit G.C.Dickson; K6 & K7; West Sussex, Ambersham Common, 24 July 1993, T.V.Sims & K.Sims, K8; West Sussex, Graffham Common, 24 July 1993, T.V.Sims & K.Sims, K10 & K12; West Sussex, Graffham Common, 5 Nov. 1992, legit T.V.Sims, K1. Scotland: Aberdeen, 26 Oct. 1958, legit J.F.Malcolmson, Henderson 4340; Argyll, Dunoon, Benmore, 18 Nov. 1977, B.Coppins, Copp. 3254; Argyllshire, Kilmun, Argyll Forest, 22 Sept. 1991, R.Watling, Wat 25217; Arran, Brodick Castle grounds, 15 Nov. 1992, K.Sims, K2; Edinburgh, Colinton, 4 Nov. 1989, R.Watling, Wat 22252, Edinburgh, Royal Botanic Garden, 14 Dec. 1857, legit J.Sadler; Edinburgh, Royal Botanic Garden, 23 Sept. 1973, legit J.Evitt, Wat 9728; Edinburgh, Royal Botanic Garden, Dec. 1857, Davies & Sadler; Falkirk, Maddiston, near River Avon, 13 Sept. 1985, legit N.Stewart, Wat 17575; Galloway, Port Logan, 29 Sept. 1953, D.M.Henderson, 978; Inverness-shire, Fort Augustus, 21 Sept. 1987, legit R.McBeath, Wat 20142; Mull, Craignure, between Craignure and Torosay Castle, 16 Sept. 1968, E.W.Groves; near Brucefield, Craigmad Wood, 12 Sept. 1983, legit N.Stewart, Wat 17575; near Dollar, Balfour Estate, 24 July 1990, legit I.Munro, Wat 22366; Perthshire, Kindrogan, 22 Aug. 1970, legit J.Carlisle, Wat 10092. Wales: Trymn, Pontypridd, 12 Oct. 1991, B.J.Webb.

North America

Idaho: Bonnu Co. Priul Lake, Mosquito Bay, 10 Sept. 1966, R.Watling; Wat 2918. Michigan: Chiffuva Co. Emersan, Whiteham Landing, 18 Aug. 1965, R.Watling, 846/1985A; Chiffuva Co. Kinross. 27 Aug. 1965, R.Watling, 686/A2024; Chiffuva Co. Sugar, 10 Aug. 1965, R.Watling, 683/1044C; Chiffuva Co. Whiteham Landing, 18 Aug. 1965, R.Watling, 825/A1946; Livingston Co. Pickney Recreation Area, 8 Sept. 1965, R.Watling, 894/A2061; Luce Co. Tahquamena, Pole and Tu, 25 Aug. 1965, R.Watling, 890/2054A. Pennsylvania: Butler Co. 5 miles north of Zelienople, 9 Dec. 1935, L.K.Henry.

Herb.M.C.Cooke 1885, 268, no further notes.

19 *S.floridanum* Guzmán

North America

Oregon: Lane Co. Junction City, 21 Nov. 1968, legit Mrs C.Rutherford, Trappe 1790, (NY).

21 *S.michiganense* Guzmán

North America

Michigan: Cheboygan Co. Colonial Point, 10 Sept. 1969, R.Watling, Wat 6836; Washtenaw-Jackson Co. Waterloo State Recreation Area, 17 Sept. 1965, A.H.Smith, 72655, (MICH).

22 *S.fuscum* (Corda) Fischer

Australia

A.C.T.: Canberra, 28 April 1979, R.Watling, Wat 10536.

North America

Oregon: Benton Co. Corvallis, 16 Aug. 1975, J.Trappe, Trappe 4447.

23 *S.dictyosporum* Pat.

S.E.Asia

Indonesia: Cikarawang, Jan. 1994, P.Jeffries, Nos. 1&2. Malaysia: Kepong, FRIM 22 Mar. 1993, E.Turnbull, ET55; Selangor, near Kuala Lumpur, Kepong, 5 April 1993, R.Watling, Wat 25191; Pahang, Tembeling, 26 May 1931, E.J.H.Corner; *ibid* 27 May 1931, E.J.H.Corner. New Guinea: Wau, Morobi District, 25 May 1964, E.J.H.Corner. Philippines: Makiling, 23 June 1992, legit P.Jeffries, Wat 24987 & 24990; Biotech, 15 June 1993, K.Sims, K26; Makiling, 21 June 1993, Mycorrhiza Lab. Staff, K27; Quezon, 29 June 1993, K.Sims, K28-K30; Makiling, 30 June 1993, K.Sims, K31. Singapore: Jungle Botanic Gardens, Sept. 1929, E.J.H.Corner, Malay Peninsula (4); Maranta

Arsenal, 12 April 1930, E.J.H.Corner, malay Peninsula (4); 31 Aug. 1939, E.J.H.Corner, Malay Peninsula (6).

24 *S.hypogeum* Zeller

Central America
Mexico: Salazar, Cerro de la Campana, 1 Sept. 1963, M.Gispert & T.Herrera, 1757, (MICH).

25 *S.meridionale* Dem. & Mal. (= *S.macrorrhizon* Wall.)

North America
Michigan: Douglas Lake, UMBS, 18 Aug. 1965, D.Robson, 723/1182A; Pellston, Michigan University Biological Station, 1965, G.Guzmán, U-465, (K).

26 *S.bovista* Fr.

Europe
Denmark: Moen, Moens Klinteskov, 18 Sept. 1890, R.Watling, Wat 13732. France: 1814, legit Bulliard, Herb.M.C.Cooke 1885. UK, England: Essex, Hockley, 6 Oct. 1982, legit J.S.I.Kinner, Wat 16565; Hampshire, Garden of Flagstones, 3 Nov. 1992,legit G.C.Dickson, K4; Leicestershire, near Rothley, Sept. 1972, legit Miss Fieldhouse, Wat 9319. Scotland: Aberdeen, D.Dickie, Herb.M.C.Cooke 1885; Edinburgh, 96 Greenback Crescent, 20 July 1982, Mrs Fraser, Wat 14388; Edinburgh, Blinkbonny Avenue, 14 Oct. 1991, R.Watling; Edinburgh, Royal Botanic Garden, 15 Aug. 1977, legit C.Ainsworth, Wat 12455; Midlothian, between Auchendinny and Penicuik, Aug. 1984, legit W.Baird, Wat 17581; Mull, near Craignure, Torosay Castle, 16 Sept. 1968, legit E.W.Groves, Wat 7233.
S.E.Asia
Malaysia: Jan. 1967, legit G.Hadley, Wat 24861.
North America
Michigan: Cemmek Co. Carp Creek, 22 Aug. 1965, R.Watling, 751/1258A. South Carolina: Nov. 1881, H.N.Ranench.

27 *Scleroderma* sp.2

S.E.Asia
Malaysia: Pahang, Cameron Highlands, 6 Aug. 1934, E.J.H.Corner.

DISCUSSION

The evaluation of biodiversity is becoming an extremely important part of conserving the environment and the naming of biological species depends on good systematics.

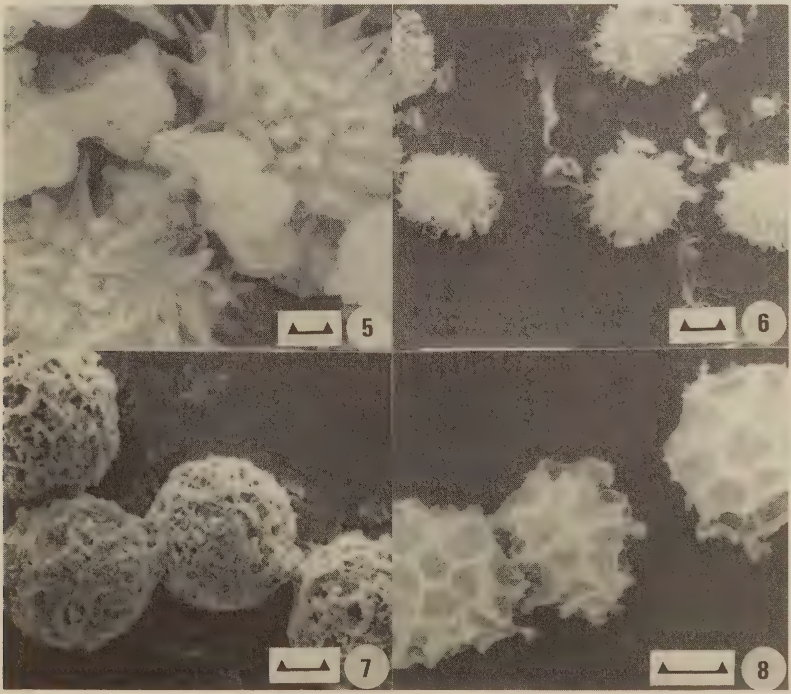
The members of the Sclerodermataceae are known to be important ectomycorrhizal symbionts, and are being used in inoculation programmes for reafforestation (Smits, 1992). It is essential in comparative studies of this type that the identity of the mycobiont is known, so that appropriate host/fungal combinations can be selected. The key has the advantage that it depends solely on characters that are easily determined by using a hand lens in combination with a light microscope. It has been used successfully to identify new collections of *Scleroderma* from Peninsular Malaysia, the Philippines and Indonesia, and allowed unequivocal placing of every specimen (unless immature) into an appropriate taxon. Therefore, this new key should provide a basis for critical reappraisal of this genus throughout the world. The genus is distinct, but some confusion can arise if only immature specimens are examined.

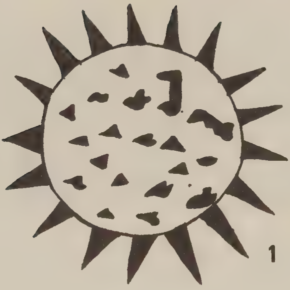
FIGURE LEGENDS

Figs.1-4 (Overleaf) Typical examples of the four categories of spore morphotypes. Fig.1 echinulate; Fig.2 verrucose; Fig.3 sub-reticulate; Fig.4 reticulate.

Figs.5-8 (Below) S.E.M. micrographs showing the four spore morphotypes. Fig.5 *S.verrucosum* (Bar=10µm); Fig.6 *S.verrucosum* (Bar=5µm); Fig.7 *S.polyrhizum* (Bar=5µm); Fig.8 *S.dictyosporum* (Bar=5µm).

Figs.9-35 (Overleaf) Line drawings of spore ornamentation of each of the species described in the key. Fig.9 *S.leptopodium*; Fig.10 *S.columnare*; Fig.11 *S.verrucosum**[1]; Fig.12 *S.areolatum*; Fig.13 *Scleroderma* sp.1; Fig.14 *S.verrucosum**[2]; Fig.15 *S.albidum*; Fig.16 *S.laeve*; Fig.17 *S.uruguayense*; Fig.18 *S.cepa*; Fig.19 *S.texense*; Fig.20 *S.sinnamarense*; Fig.21 *S.stellatum*; Fig.22 *S.polyrhizum*; Fig.23 *S.reae*; Fig.24 *S.echinatum*; Fig.25 *S.citrinum* B; Fig.26 *S.floridanum*; Fig.27 *S.citrinum* A; Fig.28 *S.michiganense*; Fig.29 *S.fuscum*; Fig.30 *S.dictyosporum*; Fig.31 young *S.dictyosporum*; Fig.32 *S.hypogeum*; Fig.33 *S.meridionale*; Fig.34 *S.bovista*; Fig.35 *Scleroderma* sp.2.

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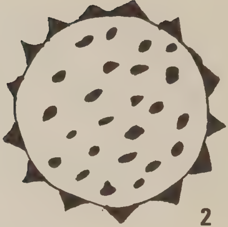
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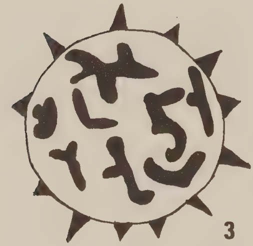
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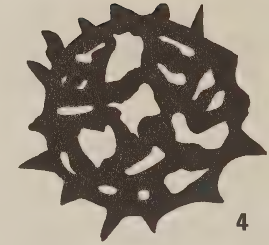
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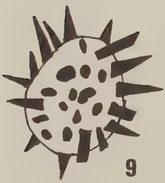
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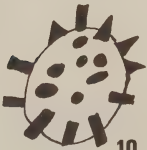
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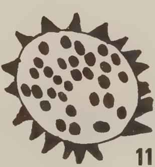
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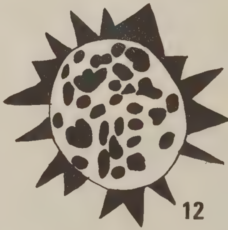
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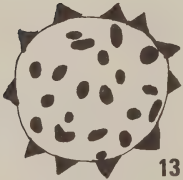
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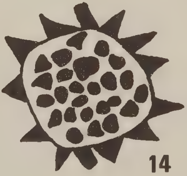
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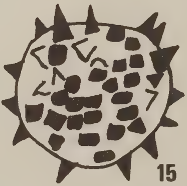
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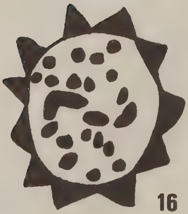
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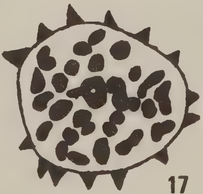
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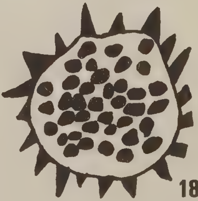
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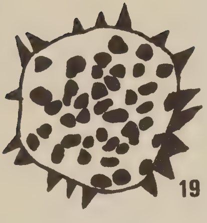
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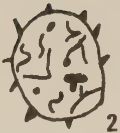
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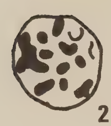
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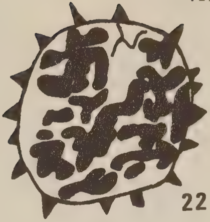
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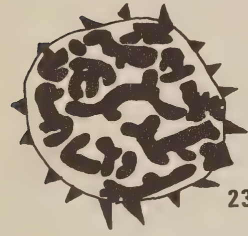
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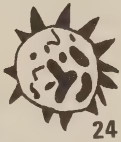
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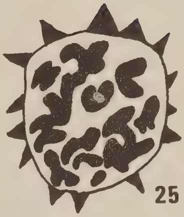
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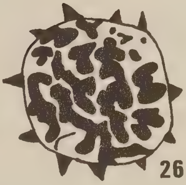
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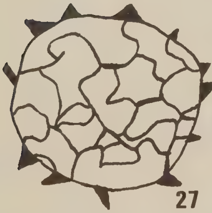
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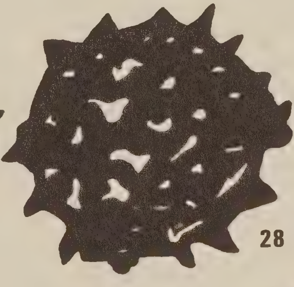
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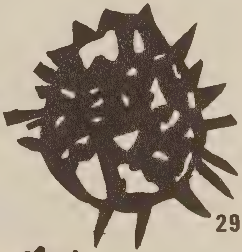
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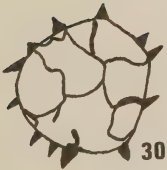
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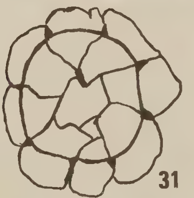
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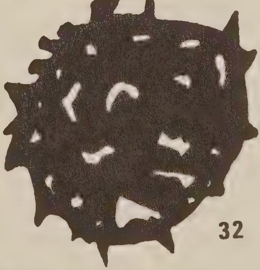
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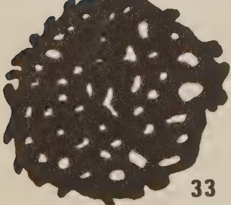
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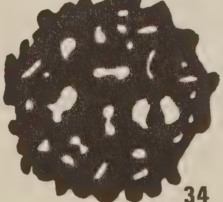
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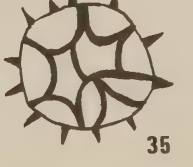
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We thank Prof. Dr. Agerer and Dr. M.Ivory for constuctive criticism of the original manuscript. We also thank Ray De La Cruz, Yadi Setiadi, E.J.H.Corner and Mike Ivory for supplying specimens from their collections.

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MYCOTAXON

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TULOSTOMA FIMBRIATUM, THE CORRECT NAME FOR *TULOSTOMA READERII*

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Abstract: The synonymy of *Tulostoma readerii* and *T.fimbriatum s.lato* is proposed based on the study of the type material of the former species. Some photographs under light and scanning electron microscope are presented.

Key words. *Gasteromycetes*, taxonomy, *Tulostoma fimbriatum*, *Tulostoma readerii*.

Within the genus *Tulostoma* Pers.: Pers. are included still doubtful or "critical" species that must be restudied. Some of them have been scantily collected; others have holotypes in very poor shape or are lost. Sometimes, the problem is that access to collections in some herbaria is restricted. In the past years we have attempted to solve some of these taxonomical problems proposing some synonymies, viz.: *T.simulans* Lloyd and *T.beccarianum* Bres. (ALTÉS & MORENO, 1993); *T.squamosum* Gmel.:Pers., *T.verrucosum* Morg. and *T.mussooriense* P.Henn. (MORENO *et al.*, 1992); *T.subfuscum* White and *T.hollosii* Moravec, and the combination *T.pulchellum* Sacc. var. *subfuscum* (White) Wright, Moreno & Altés (MORENO *et al.*, 1992). In this paper we have centered our study on *Tulostoma readerii* Lloyd, taxon described (LLOYD, 1906) on the basis of material collected by Mr. F.M.Reader in Australia, and whose distribution was restricted to that country.

MATERIAL AND METHODS

The material studied was requested on loan from The National Fungus Collections, Beltsville, Maryland, U.S.A. (BPI), and was compared with collections from the following herbaria: University of Baja California, Ensenada, Mexico (BCMEX), Museum National d'Histoire Naturelle, Paris, France (PC), and University of Alcalá, Madrid, Spain (AH).

The methods used to obtain the photographs under light and scanning electron microscope are those indicated in MORENO *et al.* (1985).

To determine the color of the gleba we have followed LOCQUIN (1975), indicating within brackets the corresponding color code.

DESCRIPTION

Tulostoma readerii Lloyd, The Tylostomeae, p. 21, 1906. (FIGS. 1-6)

The holotype consists of 5 well-preserved basidiocarps of 45-54 mm length. *Spore sac* 12-15 x 8-12 mm, subglobose. *Mouth* fibrillose-fimbriate. *Exoperidium* hyphal, mixed with sand grains, brown, persistent at the base of the spore sac. *Endoperidium* membranous, cream coloured, with numerous pits from the sand grains. *Gleba* ferrugineous (phaeotus J2g). *Stem* 38-47 x 2,5-3,5 mm, dark dirty brown, rather straight although sometimes slightly recurved, longitudinally rugose-striate, ending in a small basal bulb (up to 5 mm diam).

Exoperidium formed by 3-5,5 µm diam hyphae with not very thickened walls, with abundant crystalline remains on their surface, branched, septate, ochraceous, not broadened at the septa. *Endoperidium* formed by 3-8 µm diam, more or less thick-walled, intermingled, branched hyphae, subhyaline to pale yellow, usually broadened at the numerous septa

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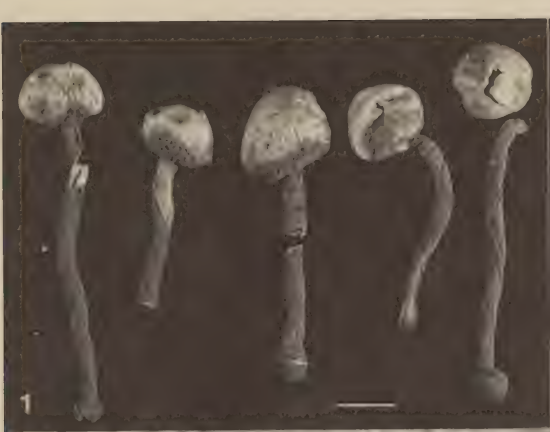
FIGS. 1-6. *Tulostoma readerii*, Holotype BPI 15421. 1: Basidiocarps with remains of hyphal exoperidium and dark stems. 2: Detail of a spore sac with fibrillose-fimbriate mouth. 3-4: Capillitial septa. 5-6: Spore ornamentation under SEM.

FIGS. 7-8. Spore ornamentation under SEM of ***Tulostoma fimbriatum***. 7: Herb.Quélet at PC. 8: AH 13114.

Scale bars: FIG. 1 = 1 cm. FIG. 2 = 0,5 cm. FIGS. 3,4 = 15 µm. FIGS. 5-8 = 1 µm.



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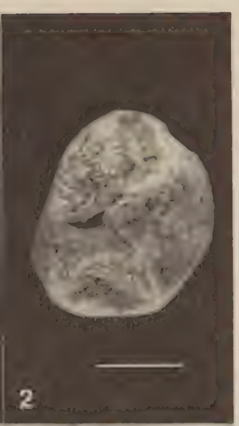

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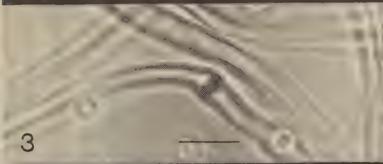

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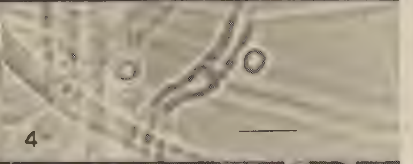

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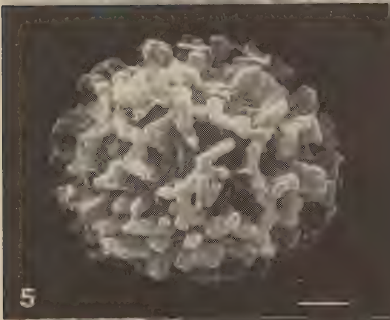

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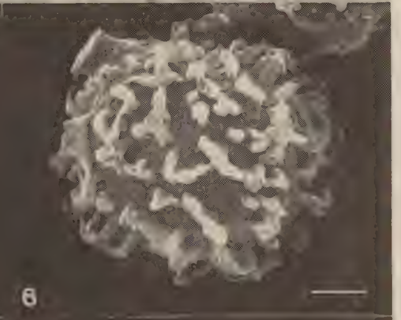

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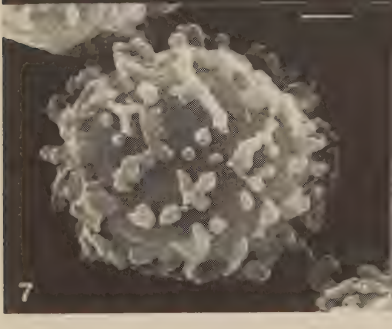

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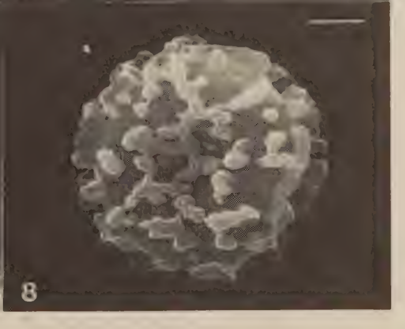

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(up to 12 µm diam.), some septa ochre coloured. *Spores* 5-7 µm diam, globose to subglobose, pale yellow, echinulate under LM; under SEM verrucae and crests of variable size and shape are observed, sometimes forming a subreticulum. *Capillitium* 4-11 µm diam, with irregularly thickened walls (up to 3 µm), branched, septate, subhyaline, slightly or not at all broadened at the septa, which are hyaline or pale ochre.

Material studied. AUSTRALIA: F.M.Reader, 12-VI-1898 (HOLOTYPE BPI 15421). FRANCE: Montmorency, 25-XI-1894 (Herb.Quélet at PC, as *T.granulosum*). MEXICO: Baja California, San Quintín-El Rosario highway, 11-XI-1984, C.Ochoa (BCMEX 1834). TUNISIA: Tebessa-Bou Chebka, I-1893 (PC, as *T.granulosum*). SPAIN: Madrid, Alcalá de Henares, 1-III-1991 (AH 13114). U.S.A.: California, Stanislaus Co., Turlock, K.Mitchell (BCMEX 1846).

Remarks: WRIGHT (1987) considers *Tulostoma readerii* a species close to *T.fimbriatum* Fr. var. *campestre* (Morgan) Moreno. LLOYD himself (1906) points to the similarity between the new species he describes and *T.granulosum* Lév., which is now accepted as a synonym of *T.frimbriatum.* The differences between the 6 varieties plus a form of *T.fimbriatum* recognized by WRIGHT (1987) are dubious to us, for which reason we prefer to consider only a single taxon *T.fimbriatum s.lato*. This includes basidiocarps of variable size, with a typically frimbriate mouth, sometimes denticulate, a clearly hyphal exoperidium mixed with sand grains or soil, cream coloured to pale ochre endoperidium, which may be smooth or pitted from the sand grains, ferrugineous gleba, spores of fairly variable size with a clear verrucose-echinulate ornamentation under LM, which under SEM is formed by crests and verrucae of variable length, which sometimes appear as subreticulate (figs. 7-8); capillitium subhyaline with thick walls, somewhat enlarged at the slightly ochre septa. Since *T.fimbriatum* is one of the most common taxa in Europe, we have been able to study in the last few years numerous collections, mostly Spanish and extant in AH, but also some from other countries, of which only a few have been listed among the material studied.

The study of the holotype of *T.readerii*, particularly of its sporal ornamentation, shows that it does not exhibit important differences with *T.fimbriatum s.lato*, and thus we are proposing their synonymy.

Tulostoma fimbriatum Fr., Systema Mycologicum 3:43. 1829.
= *T.readerii* Lloyd, The Tylostomeae, p. 21. 1906.

ACKNOWLEDGEMENTS

We wish to express our gratitude to Dr. J.E.Wright for his comments and the translation from Spanish, and to Dr. F.D.Calonge for revising the manuscript. Thanks are due to curators of the herbaria BPI, PC and BCMEX for the loans. To J.A.Pérez and A.Priego for their unvaluable help with the SEM. This work has been financied by DGICYT PB 91-0165.

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MYCOTAXON

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STUDIES IN TROPICAL AFRICAN *LACTARIUS* SPECIES. 2. *LACTARIUS CHROMOSPERMUS* PEGLER

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1. ABSTRACT

A detailed and extensively illustrated description of *Lactarius chromospermus* Pegler, first described from Zambia, is provided on the basis of abundant material from miombo woodland in Burundi (Central Africa). Its ectomycorrhizal association with *Brachystegia* is demonstrated. Microscopic features of the type material are reexamined and compared with those of the collections from Burundi. Its systematic position is discussed.

2. INTRODUCTION

PEGLER (1983) described *Lactarius chromospermus* from a single collection made by ROSE in the miombo woodlands in Luapala Prov., Zambia. This *Lactarius* species extends considerably the concept of Russulales because of its dark brown spore-print. Notwithstanding this important difference, Pegler included it in *Lactarius* sect. *Dulces* R. Heim ex Singer subsect. *Lactifluini* (Burl.) Singer because of inferred relationships with *Lactarius volemus*.

3. MATERIAL AND METHODS

The present description is based on specimens collected during 1991-1993 in western Burundi by the senior author (priv. coll.) and in 1994 by both authors (coll. VERBEKEN, deposited at BR and GENT).

Microscopic features are studied in congo-red in NH_4OH (eventually after a short passage in KOH 10% solution). Spore ornamentation is described and illustrated as observed in Melzer's reagent. Terminology of cystidial elements is according to BUYCK (1991). Line-drawings are made by VERBEKEN with the aid of a drawing tube at magnifications 6700x for spores, 3200x for individual elements and 1100x for sections and surface views. Stippling indicates refractive contents in cystidia and lactifers.

Spores are measured in side view in Melzer's reagent, excluding the ornamentation and measurements are given as (MINa) [AVa-2*SD] - *AVa - AVb* - [AVb + 2*SD] (MAXb) in which AVa = lowest mean value for the measured collections, AVb = greatest mean value and SD = standard deviation. Q stands for "quotient length/width" and is given as (MINQa) *Qa - Qb* (MAXQb) in which Qa, respectively Qb, stand for the lowest, respectively the highest, mean quotient for the measured specimens.

Colour codes are from KORNERUP & WANSCHER (1978). L+l/cm means number of lamellae (L) and lamellulae (l) per cm at pileus mid-radius. Names of phytogeographical regions and vegetation types are according to WHITE (1983).

4. DESCRIPTION OF THE COLLECTING SITES

Most specimens were collected on the eastern slope of Nkayamba hill at the northern limit of Rumonge, a small town at the border of lake Tanganyika, approximately 70 km S of Bujumbura. Some of the specimens were collected at Nyamirambo, a few km SE of Nkayamba. Mean annual rainfall in this region is 1057.3 mm for the period 1980-1986 (IGEBU, 1986 - observations stopped in 1987), but with important differences between years. Precipitation is most abundant in November, December and April. Mean annual temperature for the same period was 23.75 °C.

The vegetation at Nkayamba consists of an old *Brachystegia* woodland dominated by *B. microphylla* Harms, near the summit, *B. bussei* Harms and *B. utilis* Burtt Davy and Hutch. on the lower slope, and *B. spiciformis* Benth. growing more dispersed over the entire slope. All examined *Brachystegia* species are proven to be ectomycorrhizal (HÖGBERG, 1982; HÖGBERG & PIEARCE, 1986). Near the top, the vegetation develops on an acid sandy soil (pH 4.6 on the upper slope) which is severely eroded showing abundant rock debris everywhere. The organic superficial layer is very thin, but most of the remaining surface is covered with well-developed moss cushions of *Leucobryum madagassum* Besch. and *Campylopus savannarum* (C. Müll.) Mitt. Towards the lower slope, the soil becomes more basic (pH 5.3) and contains up to 50% clay (NZIGIDAHERA, 1993); mosses and rocks are replaced by various herbs and grasses. The site is under great demographic pressure and trees are being cut at an alarming rate. These clearings result in drought stress during most of the year and mushrooms are only abundant in weeks of heavy rain fall, especially at the beginning of the rainy season (Nov.-Dec.). Nkayamba has been visited almost weekly during the entire period.

Nyamirambo hill belongs to a protected woodland area which was exploited until 1972, mainly for the cultivation of manioc. Since the creation of the forest reserve, a young and dynamic woodland forest developed in the area. The limy soil shows less rock debris, and supports a relatively dense vegetation with numerous young shoots of *Brachystegia* and *Uapaca*. This results in well buffered microclimate with an almost equal seasonal distribution of mushroom basidiomes (Oct.-Nov. to May-June). Dominant ectomycorrhizal trees are *Brachystegia bussei* and especially *B. utilis* and *Uapaca nitida* Müll.-Arg.. Occasionally, *B. spiciformis*, *Isoberlinia angolensis* (Welw. ex Benth.) Hoyle & Brenan and, near the top, *B. microphylla* constitute the other ectotrophic partners.

Coloured illustrations of both collecting sites are given by BUYCK (1994b).

5. RESULTS

Lactarius chromospermus PEGLER, Kew Bull. 37: 107 (1982).

Pileus 4.5-14(17) cm diam., very firm, fleshy, plano-convex to applanate and slightly depressed, subumbilicate to umbilicate; margin inflexed to involute when young, straight or sometimes revolute and irregular in older specimens; pellis dehiscent only near the extreme margin, smooth, dry, greasy when humid, finely areolate when old, cream-colour, pale yellow to greyish yellow and greyish orange (4AB4-5, 5B3), seldom entirely this colour, shaded with reddish brown to greyish beige (5A2, 6CD5-6) or even locally dark brown (7C2). *Stipe* 2.5-8 × 1-3 mm, subcylindric, firm, solid to fistulose, cream-colour to pale yellowish (3A2, 4A2), whitish pruinose in the upper half, leaving finger-prints when bruised, turning brownish grey near the stipe-base. *Lamellae* subfree to narrowly adnate, arcuate to subventricose, easily separable from the pileus-trama, dense (3+4 to 6+13/cm), unequal with 1-3(5) lamellulae between two lamellae, (2)6-10 mm broad, thin, paper-like, greyish orange (5B4) when young, dirty brown when bruised, dark brown (6F5-6 to 9EF4-5) at maturity; edge even, slightly paler. *Context* (3)6-12 mm thick in the pileus, whitish, strongly greying when cut, especially in the stipe-cortex, turning brownish in the central part of the stipe when older and when bruised; taste mild or bitter to faintly acrid, not particularly unpleasant; smell strong and unpleasant, more or less spermatic. *Latex* scarce to quite abundant, white, yellowish on drying; taste mild to slightly acrid. *Spore deposit* dark brown (7F3-5) when fresh, fading to chestnut brown (5F7-8).

Spores ellipsoid, (7.6)8.0-*8.7-9.0*-9.7 × (6.8)7.0-*7.6-8.8*-8.6 µm (Q = 1.04-*1.12-1.14*-1.22; n = 120); ornamentation strongly amyloid, composed of a partial, very irregular reticulum; ridges < 1(1.5) µm high; a few isolated warts present; meshes smaller on the adaxial side; plage distinct, not amyloid. *Basidia* 48-64 × 10-13 µm, clavate to ventricose, sometimes with slightly thickened wall, 4-spored; sterigma 4-7 × 2-3 µm. *Macropleurocystidia* abundant, (30)62-83 × 8.8-13(14) µm, cylindric to fusiform or ventricose, near the apex often with irregular, knotty protuberances, thin-walled; content slightly granular to needle-like. *Pseudopleurocystidia* (2)3-5 µm diam., cylindric to irregularly tortuous, obtuse, sometimes forked, often slightly subterminally restricted; content densely oleiferic, sometimes granular. *Lamella-edge* sterile with small, cylindrical to clavate, 0-1(2)-septate marginal cells. *Hymenophoral trama* irregular, composed of delicate, hyaline hyphae of 3-6 µm diam.; sphaerocytes only near the pileus trama; oleiferic hyphae very abundant, (2)2.5-5 µm diam., sometimes branching; lactiferous hyphae abundant, frequently branching, 5-8 µm diam. *Pileipellis* one-layered, 50-100 µm thick, with a gelatinous matrix at least when young; composed of densely interwoven, recumbent to ascending hyphae and the extremities of lactiferous and oleiferous hyphae; terminal cells 20-55 × 3-6 µm, cylindrical, unbranched, obtuse, sometimes slightly tortuous; pileocystidia scarce and obscure, 43-80 × 3-6 µm, capitulate or tapering upwards, with poor, needle-like content. *Stipitipellis* resembling the pileipellis but with more lactiferous hyphae; caulocystidia numerous, 32-38 × 2-4 µm, capitulate. *Ectomycorrhizal sheath* with distinct lactiferous hyphae and numerous myceliocystidia measuring 45-70 × 2-4 µm. *Clamp-connections* absent.

VERNACULAR NAMES AND ETHNOMYCOLOGICAL NOTES: The people of Rumonge call *L. chromospermus* "Igisazi", which is a general name for inedible mushrooms. Although only few species in Russulaceae are consumed in Burundi (BUYCK, 1994b), this rejection might be related to the dark brown lamellae, which give the species the appearance of an *Agaricus*, a genus usually regarded as being toxic in Africa (see e.g. BUYCK, 1994b; HÄRKONEN et al., 1993; RAMMELOO & WALLEYN, 1993).

HABITAT: miombo woodland.

DISTRIBUTION: *Lactarius chromospermus* seems a rare species, which might be possibly restricted to a small part of the Zambezian phytogeographical region. We assume that this species does not occur in the well explored sites of the rain forests of the Guineo-Congolian phytogeographical region. Examined collections:

Burundi, Bururi Prov.– *Miombo woodland* dominated by *Brachystegia utilis*: Nkayamba, just N of Rumonge, 850-950 m alt., associated with *Brachystegia* spp., 03-1992, BUYCK 4237, 4247, 4264, 4265, 4305; ibid., 04.1992, BUYCK 4370, 4384, 4436; ibid., 11.1994, BUYCK 4555, 4556, 4626-4628; ibid., 12.1992, BUYCK 4739, 4741, 4742; ibid., 01.1993, BUYCK 4919; ibid., 03.1993, VERBEKEN 94.148; Nyamirambo, Rumonge Forest Reserve, 850-950 m alt., associated with *B. utilis*, 03.1993, BUYCK 5134; ibid., 03.1994, VERBEKEN 94.387, 94.467, 94.468; ibid., 04.1994, VERBEKEN 94.555 [collections Buyck in priv. herb. BUYCK, collections Verbeken deposited at BR, GENT].

Tanzania, Southern Highlands Prov.– Degraded *Miombo woodland* with *Brachystegia* and *Uapaca*: Njombe distr., between Sengele and Masaulva, 1500 m alt., 02.1993, SAARIMÄKI ET AL. 1539 (H).; Morogoro Prov.– *Miombo woodland*: Morogoro distr., foot of Uluguru Mts., associated with *Brachystegia microphylla* (MUNYANZIZA, 1994).

Zambia, Luapala Prov.– *Miombo woodland*: Manga, in small group under tree, 12.1978, ROSE 7811 (holotypus K).

ECOLOGY: The collections from Nkayamba show a clear preference for the wetter parts on the limy soil, where hundreds of carpohores were found. When considering the closest tree(s) to the carpohores as the most likely ectomycorrhizal host(s), *L. chromospermus* might have been associated 13 times with *B. utilis*, 8 times with *B. bussei*, 5 times with *B. microphylla* and once with *B. spiciformis*. These observations, together with the additional data from the Tanzanian collections (see above), seem to indicate that *L. chromospermus* forms only ectomycorrhizal associations with *Brachystegia* species. However, ectomycorrhizal associations with other tree genera can not be excluded as this seems a common phenomena in tropical Africa (see HÄRKONEN, BUYCK et al., 1993, BUYCK et al., 1995). High host specificity might be confined to more or less monospecific or single-dominant vegetation types, as is often the case in colder climates.

6. DISCUSSION

6.1. Differences with the type description

When comparing our measurements of spores, basidia, and cystidia of the type with those provided by PEGLER (1983), some important differences are observed, in particularly concerning measurements of spores and basidia. However, the dimensions of the specimens from Burundi agree well with our own measurements obtained as examination of the type collection:

TABLE 1. Spore, basidia and cystidia dimensions of *Lactarius chromospermus* (in µm).

	holotypus		Burundian collections
	Pegler (1983)	own measures	
Spores			
length	9.5-11.5	(7.6)7.8-*8.9*-9.9	(7.6)8.0-*8.7-9.1*-9.7
width	8.5-9.5	7.2-*7.8*-8.6(8.7)	(6.8)7.0-*7.7-8.1*-8.6
shape (Q)	1.15	1.06-*1.14*-1.29	1.04-*1.12-1.14*-1.26
Basidia			
length	40-45	48-70	48-64
width	8-10	9-12	10-13
Cystidia			
length	50-90	(25)55-83	(30)62-83
width	8-21	(6)10-14	9-13

6.2 Systematic position

We can not find any close affinities with the other African *Lactarii* described by HEIM (1938, 1955). The exceptional dark brown spore-print of *L. chromospermus* might argue in favour of placing this species in a monotypic section or even in a separate subgenus in *Lactarius*. However, as one of us (A.V.) is now studying tropical members of the genus *Lactarius*, we prefer to assign this species provisionally to one of the already recognized groups in *Lactarius* untill we have a more complete picture of the genus in the tropics.

We do not consider *L. volemus* (Fr.) Fr. to be closely related to *L. chromospermus* (Pegler, 1982) because both species have very different types of cystidia and pileipellis. When comparing the features of *L. chromospermus* with other *Lactarii* (TABLE 2), most resemblances are found with species such as *L. pallidus* (Pers.: Fr.) Fr. or *L. trivialis* (Fr.: Fr.) Fr. belonging to the subgenus *Russularia* (Fr.: Kauffman) sect. *Trivialis* Hesler & A.H. Sm. Most important difference, apart from spore colour, resides in the often strong viscosity of the latter group.

TABLE 2. Comparison of the principal features of *L. chromospermus* with those of the *L. volemus*-group and the *L. pallidus*-group.

	L. volemus-group	*L. chromospermus*	*L. pallidus*
pileus viscosity	completely dry	dry, greasy when wet	glutinous
pileus colour	rather bright yellow, red, orange or red, not dull or greyish	ferrugineous to greyish beige	greyish, brownish; somtimes more whitish, ochre
stipe interior	solid	solid, then fistulose	solid, then fistulose
taste	completely mild	mild to faintly acrid	mild or acrid
latex presence	extremely abundant	scarce to abundant	scarce to abundant
latex colour	unchanging or staining brown	white, yellow on drying	unchanging or staining yellow
lamellae colour	at first whitish to pale cream colour, darker cream with age, brownish to dark brown when bruised	greyish orange when young, then dark brown	staining greyish, brownish or olivaceous
spore print	white or pale cream	dark brown	light ochre
spore ornamentation	broad and narrow ridges together forming a partial to complete reticulum	a broken to partial, very irregular reticulum with a few isolated warts and ridges	a sparse broken to partial reticulum and some isolated warts
macrocystidia	lanceolar, wall to 3 µm thick (not always present in Lactifluini)	cilindric, fusiform or ventricose, wall 0.5-1.0 µm thick, abundant	subfusoid to ventricose, acuminate, abundant

pileipellis structure	a zone of cells bearing a turf of ascending hairs	with a gelatinous matrix at least when young, composed of densely interwoven, recumbent to ascending hyphae, no cellular elements	composed of recumbent and then ascending hyphae, with a gelatinous matrix, no cellular elements

7. ACKNOWLEDGEMENTS

We express sincere gratitudes to the Dean of the Faculty of Science and the Head of the Belgian-Burundian Cooperation at Bujumbura for fieldwork facilities, to the directors and curators of the Herbaria of Gent (GENT), Kew (K) and Meise (BR) for the loan of the specimens, to Herman Stieperaere (BR) for the determination of the mosses, to Päivi Karhula for indicating the presence of a Tanzanian collection at H, to Ruben Walleyn for useful comments and to Roy Watling (E) for reviewing this paper.

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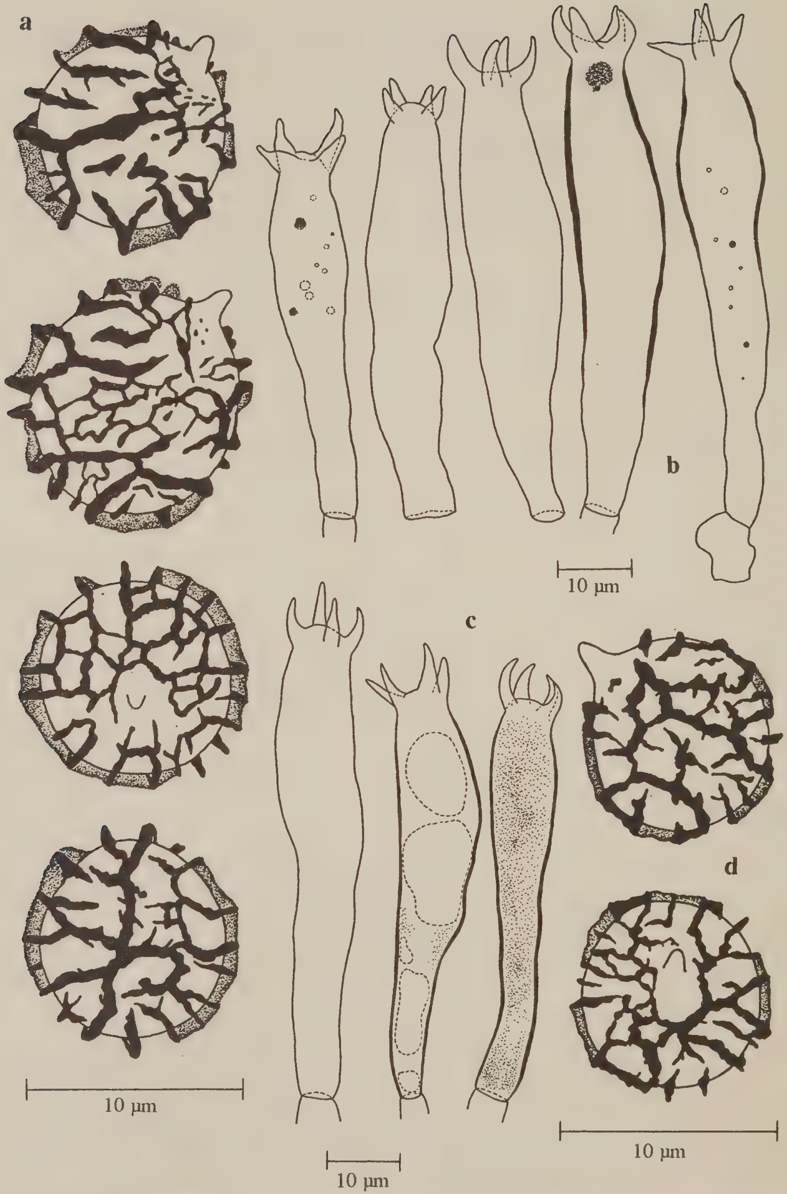

FIG. 1. ***Lactarius chromospermus*** a. Spores (HOLOTYPUS); b. Basidia (HOLOTYPUS); c. Basidia (BUYCK 5134); d. Spores (BUYCK 5134).

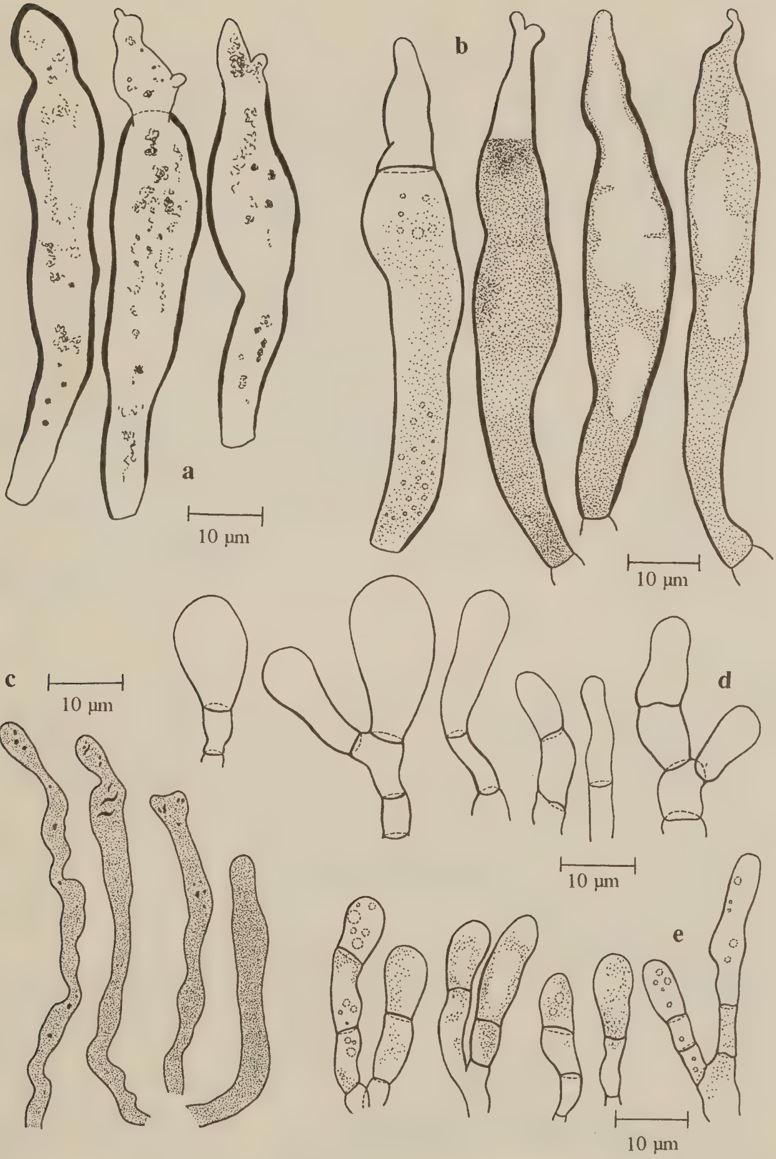

FIG. 2. ***Lactarius chromospermus*** a. Macropleurocystidia (HOLOTYPUS); b. Macropleurocystidia (BUYCK 5134); c. Pseudopleurocystidia (HOLOTYPUS); d. Marginal cells on lamella-edge (HOLOTYPUS); e. Marginal cells on lamella-edge (BUYCK 5134).

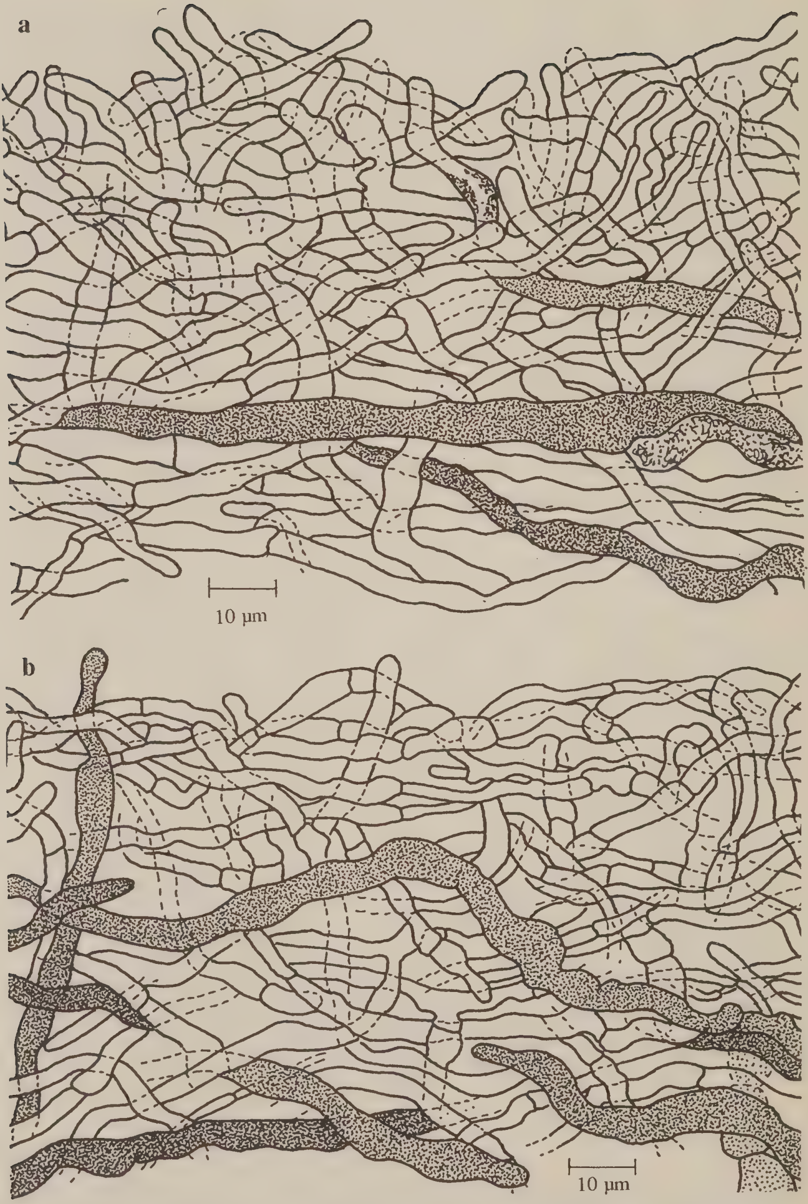

FIG. 3. ***Lactarius chromospermus*** a. Section through the pileipellis, near the centre (HOLOTYPUS); b. Section through the stipitipellis, near the apex (HOLOTYPUS).

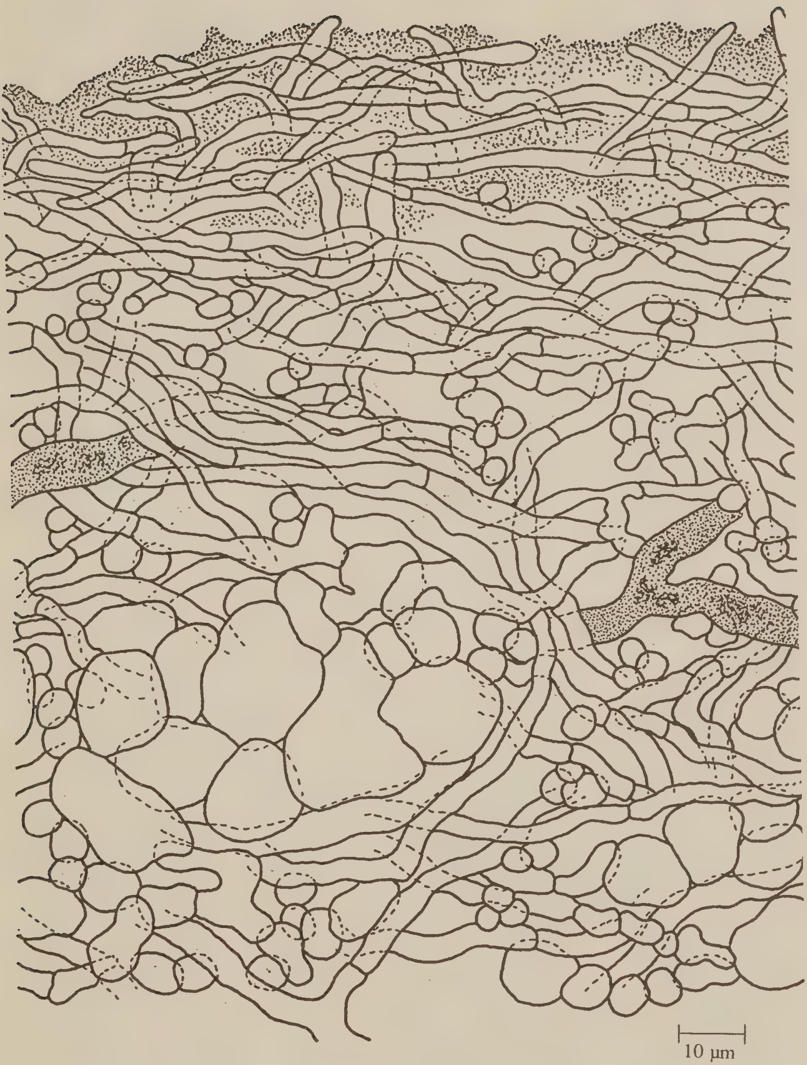

FIG. 4. ***Lactarius chromospermus*** Section through the pileipellis halfway the pileus radius (BUYCK 5134).

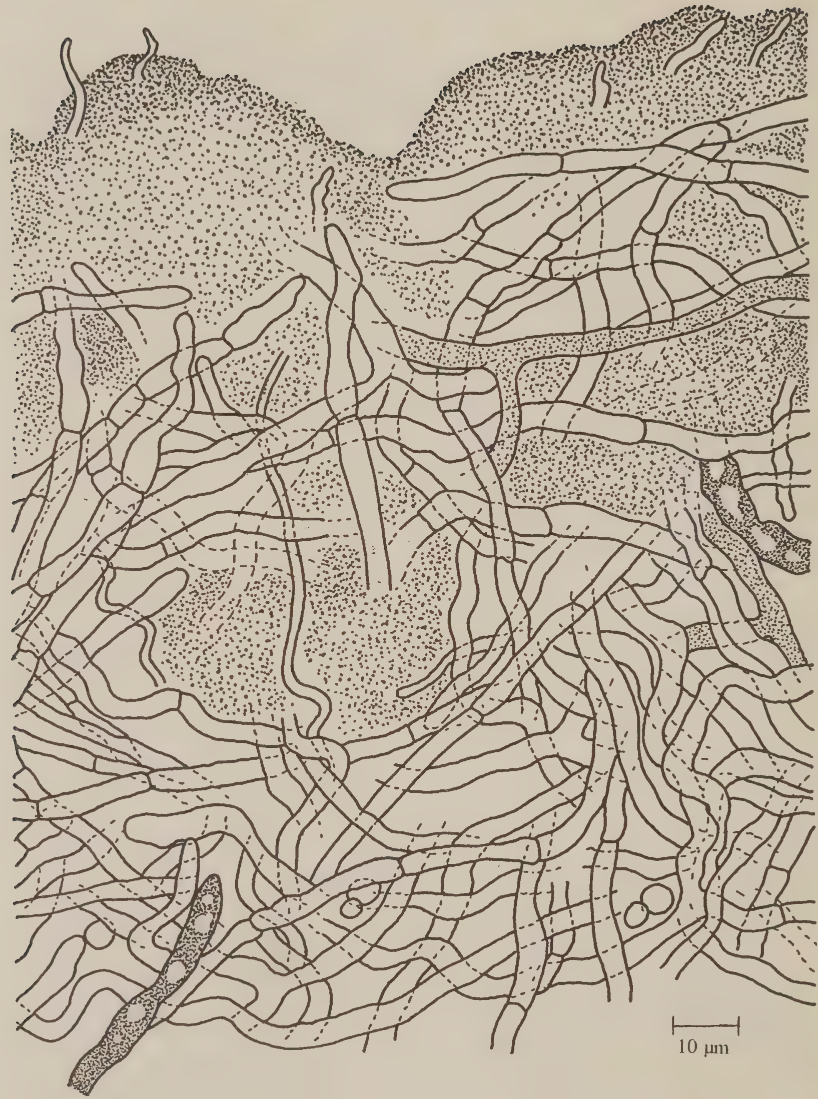

FIG. 5. ***Lactarius chromospermus*** Section through the pileipellis halfway the pileus radius, young specimen (BUYCK 5134).

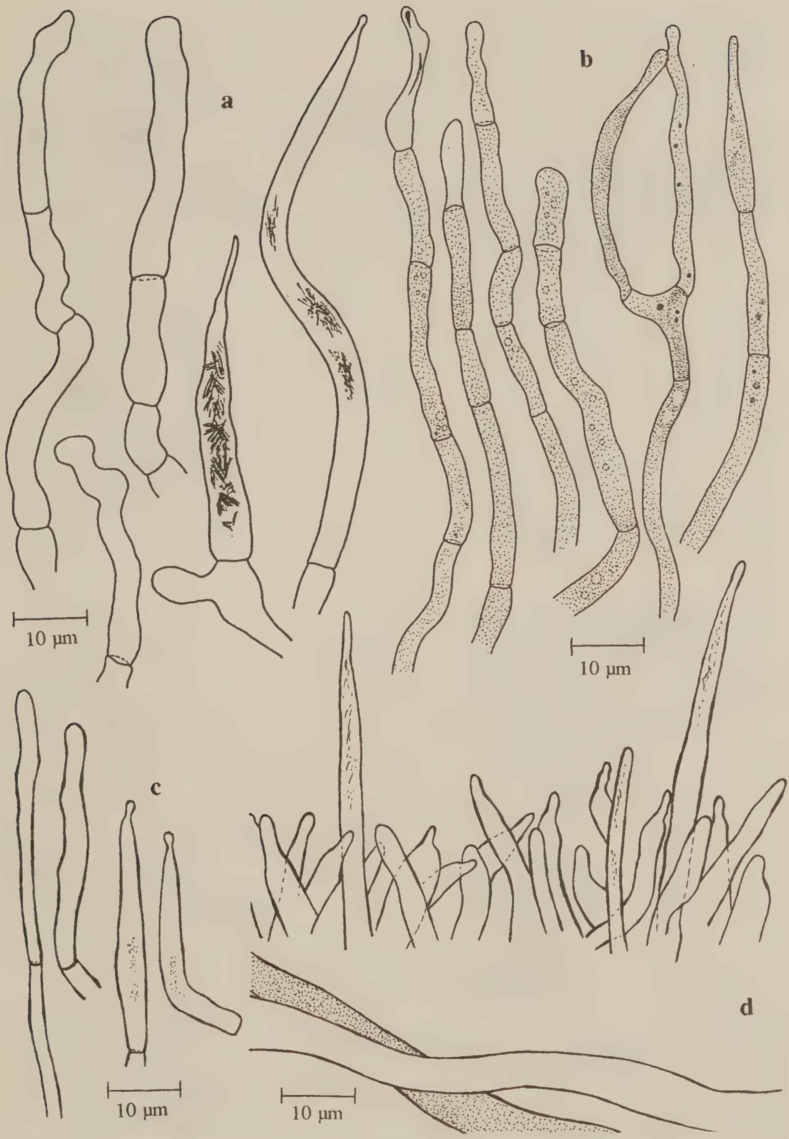

FIG. 6. ***Lactarius chromospermus*** a. Elements of the pileipellis, with pileocystidia (BUYCK 5134); b. Elements of the stipitipellis halfway the stipe (BUYCK 5134); c. Elements of the stipitipellis, with caulocystidia (BUYCK 5134); d. Detail of ectomycorrhiza, showing the lactifers and the myceliocystidia (BUYCK 5134).

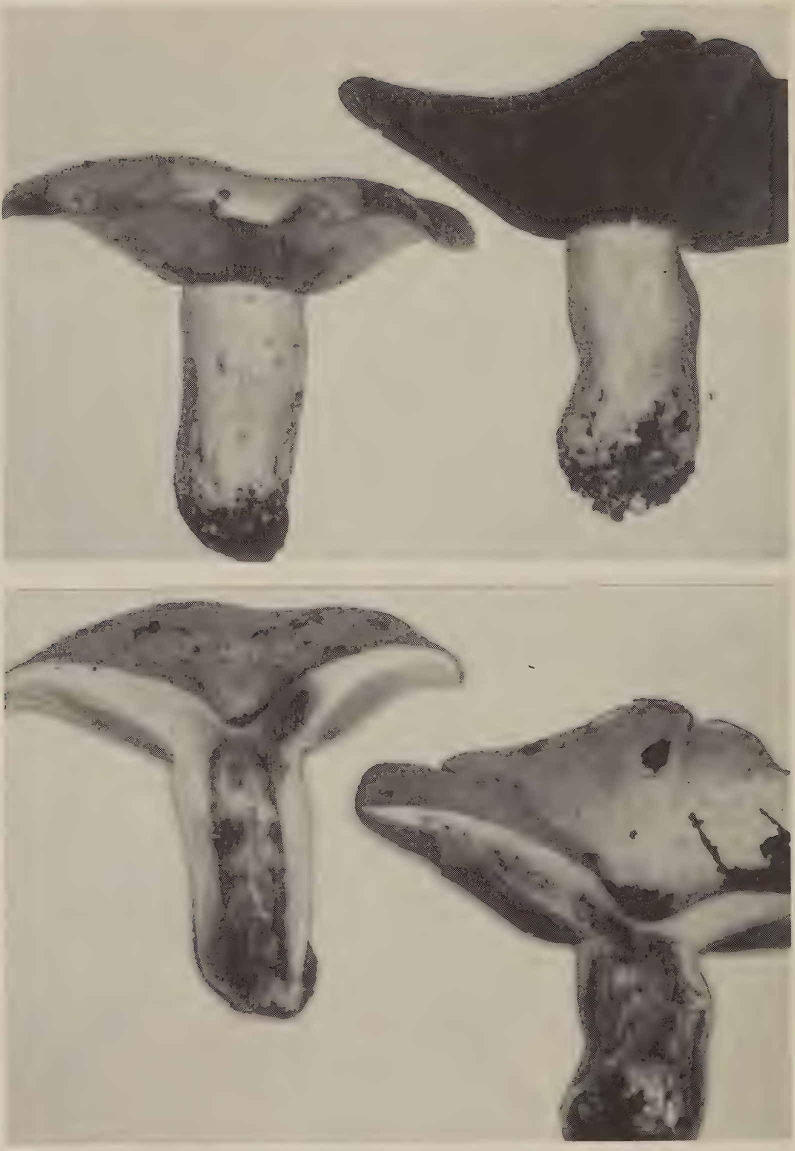

FIG. 7. ***Lactarius chromospermus*** Basidiomes, x 1/2 (BUYCK 5134).

MYCOTAXON

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Didymella viciae sp. nov., teleomorph of *Ascochyta viciae* Lib., pathogen of *Vicia sativa* in Algeria.

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Abstract: The teleomorph of *Ascochyta viciae* has been recorded for the first time on overwintering *Vicia sativa* stems in Algeria. Correlation between the 2 morphs has been proved by cultural, morphological and pathological studies. The name *Didymella viciae* sp. nov. is introduced for the teleomorph.

Résumé: Le téléomorphe de *Ascochyta viciae* a été trouvé, pour la première fois sur des tiges de *Vicia sativa* en Algérie, après l'hiver.
La corrélation entre les deux formes a été démontrée par des études culturales, morphologiques et de pathogénicité. Le nom *Didymella viciae* sp. nov. est proposé pour ce téléomorphe nouvellement découvert.

INTRODUCTION

Like many other Leguminosae, *Vicia sativa* is frequently contaminated by *Ascochyta* species such as *A. viciae* Lib., *A. pisi* Lib., *A. viciae-villosae* Ondrej, *A. punctata* Naumov (SPRAGUE, 1929; LEACH, 1962; EL SHANAWANI and OUSPENSKAIA, 1978; RICHARDSON, 1979; BOEREMA and VERHOEVEN, 1979, ONDREJ, 1968). In Algeria *A. viciae* and *A. viciae-villosae* are the most frequent (MOHAMMEDI, 1984; BOUZNAD, 1989; BENELMOUFFOK, 1993). They cause on leaves, stems and pods characteristic symptoms of blight : necrotic spots with dark margin and concentrical black pycnidia in the middle (JELLIS and PUNITHALINGAM, 1991).

A. viciae is not easy to differenciate and identify precisely by morphological data only. Specificity of the pathogenicity on *Vicia* and observation of the teleomorph may be very useful to precise and confirm the identification.

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Since 1991, frequent prospections in *Vicia sativa* fields in humid region of Collo mountains (N.E. Algeria) have shown ascomata mixed with pycnidia on overwintered stems of *Vicia sativa. Mycosphaerella pinodes* (Berkeley & Bloxam) Vestergen (current name *Didymella pinodes* (Berkeley & Bloxam)), *Mycosphaerella viciarum* Petrak and *Didymella fabae* (Jellis & Punithalingam) were already described on various *Vicia* species except *V. sativa.* So it appears we discovered a new teleomorph on *Vicia sativa.*

Materials and methods

Pycnidia and pycniospores were observed on fresh leaves, stems and pods collected in spring and ascomata and ascospores on stems collected in January, after overwintering.

Morphological observations were performed on fresh material as well as on cultures obtained from ascospores collected *in situ* and pycnidiospores collected *in situ* et *in vitro* with the mean of a micromanipulator. Fungi were cultivated on Mathur agar medium and incubated at 20-22°C under daylight.

Pathogenicity and host specificity of the isolates were evaluated by inoculation of pycniospores freshly isolated or obtained from culture, on the most important food legumes *Vicia sativa, Vicia faba, Pisum sativum* and *Lens culinaris* . Disease effect was evaluated on 5-7 days old plants after artificial inoculation under controled conditions. The inoculum consisted of a suspension of 10^6 conidia/ml prepared from ten days old cultures (Mathur medium). After inoculation, plants were incubated under plastic film to maintain saturated humidity, for 72 hours . After that period, inoculated plants were sprayed with distilled water 4-5 times each day to help development of the disease. Symptoms (leaf and stem spots) were noted 2 weeks after inoculation.

RESULTS

Anamorph description

Pycnidia black , globose to subglobose, 155-230 μm diameter (182 μm), ostiolate (50 μm) with pink cirrhi. The majority (93%) of conidia is bicellular, (12,5- 23,5 μm) with a mean of 16,78 μm long and 4,5 μm wide (2,5-6,25 μm). Rarely conidia are mono- or tricellular. They are hyaline, straight, slightly truncate at the base rounded at the apex. In culture, thalli are constituted of white appressed mycelium with numerous brown pycnidia in concentrical disposition. Chlamydospores are frequent. Structural microscopical observation shows pseudoparenchymatic conidiomatal wall with hyaline subglobose conidiogenous cells arising from the innermost layer of cells surrounding the pycnidial cavity (Fig. 1, d, e, f). Comparison of microscopical data of *A. viciae* and other species found on Leguminosae are given in table 1. *A. fabae, lentis* and *viciae* are very close.

Espèces	C. length	C. wide	C. unicel.	C. bicel.	Chlamy.	Pycnidia diam.
A. fabae	17	5	-	+++	+	235
A. lathyri	10	4,5	+	+++	+	115
A. lentis	15	4,7	-	+++	+	205
A. pisi	12	4	-	+++	0	135
A. rabiei	7	3,5	+++	+	0	75
A. viciae	16,78	4,5	-	+++	+	182
A. pinodes	11	4	+	+++	+	175

Table 1. Comparative morphological data of *Ascochyta* species on Leguminosae; means in µm.
Conidia (C.): (-)= <1%; (+)= < 4%; (+++)= > 5%. Chlamydospores (Chlamy.): (+)= presence; (0) = absence.

Teleomorph description

Didymella viciae Bouznad sp. nov.

Ascomata immersa, globulosa vel ovata, collis absentes, ostiolata 180-240 µm. Paries ascomatum pseudoparenchymaticus paucis stratis cellularum (textura angularis) compositus. Asci cylindrici bitunicatusque, octospori (55-75 x 10-13,75 µm) constricti ad basim, pedicillati. Pseudoparaphyses filiformis, hyalinis aseptatis. Ascosporae distichae, hyalinae, cellulis superioris rotundinis et latioribus quam inferis (15-17,75 x 5,5-7,5 µm).
In caulibus emortuis Vicia sativa Collo (Algeria), January 1991, in Herbarium INA, El Harrach, Algeria and PC, Paris depositus et cultura typus in LCP (Paris) deposita sub n° 95 3763.

Mixed with pycnidia, ascomata immersed in the host stem tissues. Globose to oval, dark brown, unecked, ostiolate, 180-240 µm diameter. Ascomatal wall pseudoparenchymatic, composed of a few layers of cells (textura angularis) (Fig. 1). Asci cylindrical, bitunicate, eight-spored, 55-75 x 10-13,75 µm, constricted near the base to form a distinct foot. Hyaline, non septate, filiform pseudoparaphyses. Ascospores bicellular, hyalines, smooth with uper cell broader and rounded and the lower slightly pointed at

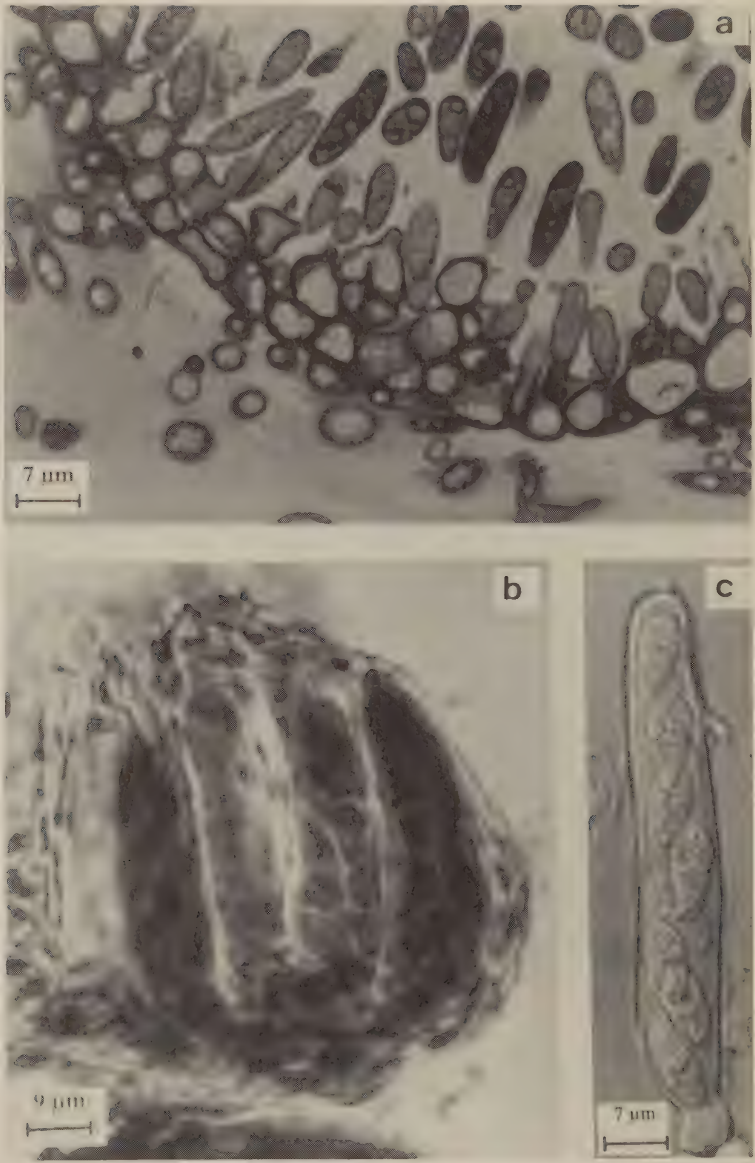

Plate 1: (a): Transverse section of *Ascochyta viciae* pycnidia showing the pycnidial wall, conidiogenous cells and conidia. (b): Transverse section of *Didymella viciae* perithecium from host plant with pseudoparaphyses. (c): Ascus of *Didymella viciae*.

the base, constricted at the septa (15-17,75 x 5,5-7,5 μm). Monoascospore cultures obtained on PDA are similar to those of *Ascochyta viciae* described above: white appressed mycelium with numerous black pycnidia in concentrical disposition.

Herbarium type specimens (Collo, Algeria, January 1991) are conserved at Herbarium INA, El Harrach, Algeria and P.C., Paris; type culture is deposited in LCP (Paris) n° 95 3763.

Specificity of the parasite

Inoculations were performed with conidia obtained from monoascospores as well as monoconidial cultures of the parasite on *Pisum sativum, Lens culinaris, Vicia faba* and *Vicia sativa.* Blight symptoms were observed only on *Vicia sativa* after two weeks on leaves and stems of inoculated plants. This result confirms the pathogenic specificity of the fungus isolated from *Vicia sativa* .

DISCUSSION AND CONCLUSION

Similarity in pathogenic, morphological and cultural features of conidiomata obtained either directly from the anamorph *Ascochyta viciae* isolated on *Vicia sativa* or from cultures originated from ascospores of the teleomorph on the host, provides with evidence of the existence of an holomorph: *Ascochyta viciae - Didymella viciae* sp. nov.

Teleomorphs of other *Ascochyta* species on Leguminosae belongs to *Mycosphaerella*: *M. pinodes* (Berk. & Blox.) Vestergr. - *Ascochyta pinodes* L.K. Jones on *Pisum sativum, Mycosphaerella. viciae* (Schroet.) Cruchet on *Vicia hirsuta* (CORLETT, 1991) and *Didymella* : *Didymella rabiei* (Kov.) v. Arx - *Ascochyta . rabiei* (Pass.) Lab. on *Cicer arietinum*, *Didymella fabae* Jellis & Punithalingam - *Ascochyta faba* Speg. on *Vicia faba.* More recently Kaiser and Hellier (1993) found a new species of *Didymella* teleomorph of *Ascochyta fabae* f. sp. *lentis* on *Lens culinaris.*

The genus *Didymella* differs from *Mycosphaerella* in having ascospores that are broader and more constricted at the septa, the presence of pseudoparaphyses and larger ascomata (LUTTRELL, 1973; HANLIN, 1990). The features are observed in the teleomorph of *Ascochyta viciae* wich therefore belongs *Didymella* species. *D. viciae* is different from *D. fabae* and *M. pinodes* parasitic on *Vicia* spp for two reasons: the anamorph *Ascochyta viciae* is morphologically distinct from *A. pinodes* and the two morphs (ana- and teleomorph) are exclusively parasitic on *Vicia sativa* and not on *Vicia faba, Pisum sativum* and *Lens culinaris.* Nevertheless, as shown in table 1, *A. viciae* and *A. lentis* are morphologically very close to *A. fabae*. Relationships between these three species are being investigated at genomic level.

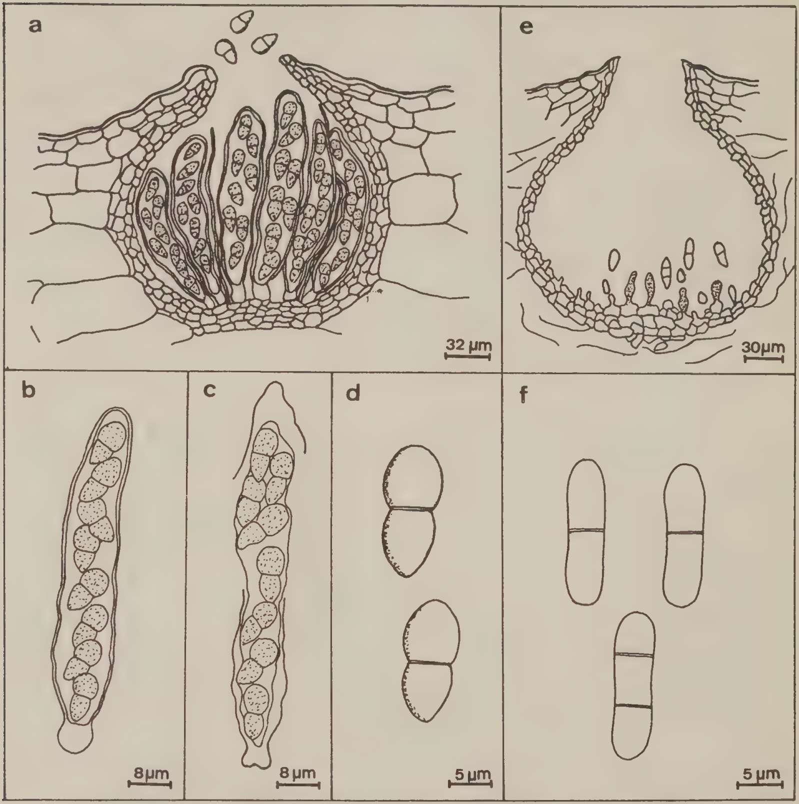

Figure 1:
Didymella viciae and its anamorph *Ascochyta viciae*: (a) ostiolated ascoma with pseudoparaphyses; (b) mature ascus with 8 ascospores; (c) dehiscent ascus; (d) ascospores; (e) pycnidium and conidiogenous cells; (f) septate conidia.

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MYCOTAXON

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TWO NEW SPECIES OF CANDELABROCHAETE (BASIDIOMYCOTINA, APHYLLOPHORALES)

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SUMMARY

Two new species of *Candelabrochaete* from Brazil and Thailand respectively are described viz.: *C. adnata* and *C. simulans*. A key to the species of *Candelabrochaete* is offered.

CANDELABROCHAETE ADNATA Hjortstam nov.sp.

Basidioma resupinatum, valde adnatum. Cystidia obclavata, rara, tenuitunicata, 40-60 x 6-8 μm, ad apicem fere subulata. Basidia subcylindrica, leviter sinuosa, tenuitunicata, 17-20 x 4-5 μm; sporis anguste ellipsoideis vel ellipsoideis, tenuitunicatis, levibus, 6.5-7(-8) x 2.8-3.5 μm.

Holotypus: Brazil, Campinas, Moji-Guaçu, Fazenda Campininha, on bamboo, 29-30 Jan. 1987, Hjortstam 16659 (K). **Isotypus**: (GB). **Paratypi**: ditto, Hjortstam 16701, on bamboo (GB, K) and 16737, on unidentified deciduous wood, (K).

Basidiome resupinate, thin, closely adnate, inseparable from the substratum. **Hymenophore** smooth, continuous, at first grey with a tint of green, than greyish to almost lead-coloured. **Hyphal system** monomitic; subicular hyphae rather loosely arranged, thin-walled to moderately thick-walled, swelling slightly in KOH, 5-7 μm wide, hyaline; other hyphae thin-walled, 3-4 μm wide; hyphae next to the basidia almost isodiametric, 5-7 μm wide; all hyphae without clamp-connexions. **Cystidia** obclavate, as a rule few, 40-60 μm long, thin-walled, smooth, 6-8 μm wide in the middle part, apically narrowing to an almost subulate tip. **Basidia** subcylindrical, slightly sinuous, thin-walled or with a slight wall thickening in KOH, 17-20 μm long and 4-5 μm wide in the upper part, with four sterigmata, linear repetition rather obscure or not seen. **Spores** narrowly ellipsoid to ellipsoid, smooth, thin-walled, 6.5-7(-8) x 2.8-3.5 μm, inamyloid, indextrinoid and acyanophilous.

This species is above all characterised by greyish and closely attached basidiome, obclavate, thin-walled cystidia and narrowly ellipsoid spores measuring 6.5-8 μm in length.

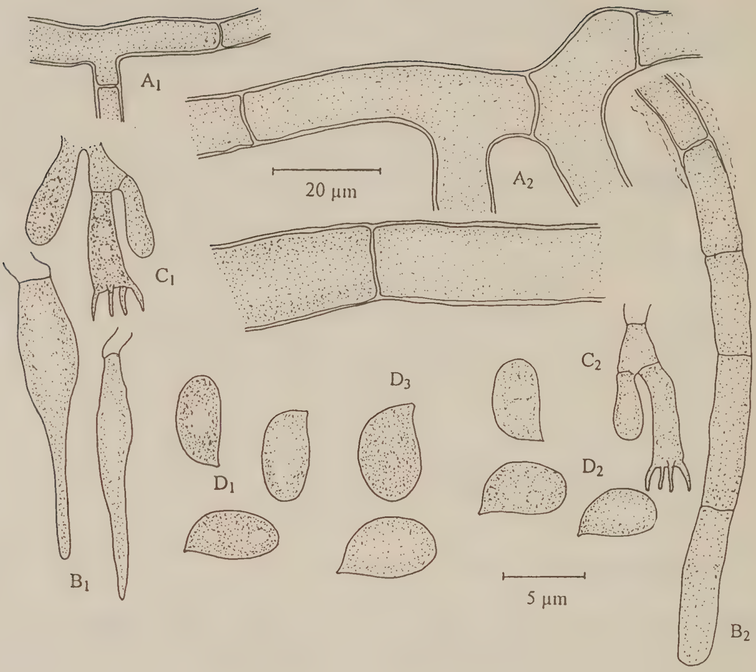

Figure. *Candelabrochaete adnata.* A1, basal hypha; B1, cystidia; C1, basidia; D1, spores. *Candelabrochaete simulans.* A2, basal hyphae; B2, cystidia; C2, basidia; D2 spores; *Candelabrochaete magnihypha.* D3, two spores.

CANDELABROCHAETE SIMULANS Hjortstam nov.sp.

Differt a Candelabrochaete magnihypha sporis brevibus, 4.5-5.5 x 3-3.2 µm; cystidiis angustis, 6-8 µm.

Holotypus: Thailand, Cangwat Chiang Mai, Amphoe Mae Chaen, Doi Inthanod, alt. 2200-2580 m, Feb. 1979, Ryvarden 17660 (K). **Isotypus**: (GB, O).

Basidiome resupinate, loosely adnate, more or less hypochnoid. **Hymenophore** smooth or slightly pilose by projecting cystidia, buff coloured. **Hyphal system** monomitic; basal hyphae thick-walled, hyaline to pale yellow, 10-15(-20) µm wide; other hyphae narrower, thin-walled or with slight wall thickening; all hyphae without clamp-connexions. **Cystidia** septate, 100-250 µm long, projecting as much as 50-75 µm above the basidia, basally thick-walled and about 6-8 µm wide, towards the apex slightly narrowing and thin-walled, not or rarely encrusted but with walls sometimes swelling in KOH. **Basidia** subcylindrical to short clavate, thin-walled, 20-25 x 4.5-5 µm, with four sterigmata, linear repetition not observed. **Spores** short ellipsoid, smooth, thin-walled, 4.5-5.5 x 3-3.2 µm, neither amyloid nor dextrinoid or cyanophilous.

Hjortstam and Ryvarden (1982) reported the holotype above as *Candelabrochaete africana* Boidin, but it is readily separated from this species by the ellipsoid and slightly smaller spores. In *C. africana* the latter are narrowly ellipsoid to cylindrical and measure 5.5-6.5 x 2.2-3 µm and the cystidia are broader and more pronouncedly thick-walled throughout. *C. simulans* appears to be most closely related to *C. magnihypha* (Burt) Burds. but can be separated by the smaller spores and narrower cystidia.

KEY TO SPECIES OF CANDELABROCHAETE

A. Spores thick-walled, cyanophilous, about 7-10(12) x 4-6 µm.
See further Burdsall (1984). **Peniophora mexicana** Burt
B. Spores thin-walled, acyanophilous **1**

1. With conidia, spores subglose 5-5.5 x 4-4.5 µm.
South America (Argentina, Brazil) **dispar** Hjortstam & Ryvarden
1. Without conidia, spores ellipsoid or allantoid **2**
2. Spores allantoid, narrow, 4.5-5(-6.5) x 1.5-2 µm; cystidia
strongly encrusted. North Temperate species **septocystidia** (Burt) Burds.
2. Spores ellipsoid or narrowly ellipsoid, if allantoid then broader than 2 µm **3**
3. Hymenophore grandinioid to odontioid. North Temperate zone,
Eastern Africa and South America (Brazil) **verruculosa** Hjortstam
3. Hymenophore smooth or almost so, but usually pilose by protruding cystidia **4**
4. Basidiome pellicular, closely adnate, not separable from the substratum,
cystidia thin-walled, subulate, smooth, spores about 6.5 x 3 µm. **adnata** Hjortstam
4. Basidiome different **5**
5. Spores allantoid, 7-8(-9.5) x 3-3.5(-4)µm, cystidia thin-walled, in KOH seemingly
encrusted with a translucent sheath. Southern USA **langloisii** (Pat.) Boidin
5. Not with this combination of characters **6**
6. Spores subcylindrical 5.5-6.5 x 2.2-3 µm.
Africa (Gabon), South America (Brazil) **africana** Boidin
6. Spores ellipsoid **7**
7. Spores 6-7(-8) x 3-4 µm;
cystidia 9-12 µm wide. USA (Florida), Costa Rica **magnihypha** (Burt) Burds.
Compare also *C. eruciformis* (G. Cunn.) Stalpers & P.K. Buchanan which has spores ellipsoid to cylindrical 6.5-10 x 3-4.5 µm (Stalpers and Buchanan, 1991).
7. Spores 4.5-5.5 x 3-3.2 µm;
cystidia 6-8 µm wide **simulans** Hjortstam

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RHIZOMUCOR ENDOPHYTICUS SP. NOV., AN ENDOPHYTIC ZYGOMYCETES FROM HIGHER PLANTS

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ABSTRACT

Rhizomucor endophyticus is reported as a new species of an endophytic zygomycetes from higher plants. Distinguishing characteristics of the new species are discussed. Latin and English descriptions of *Rhizomucor endophyticus*, as well as a key to all taxa of the genus are provided.

摘要

自北京的中国农业科学院作物栽培研究所温室的无病征小麦叶片内分离得一株内生接合菌，经鉴定为毛霉目的内生根毛霉新种 (*Rhizomucor endophyticus* sp. nov.)。

新种具有很多不寻常的特性。首先，内生接合菌或内生毛霉过去均鲜有报道，特别是高等植物的内生接合菌或内生毛霉更未见有正式报告。其次，根毛霉属的已知种大多数是高温真菌，而新种则为常温真菌，其最适、最高、最低生长温度在整个属内都是最低的。第三，根毛霉属内本来已有几个同宗配合的种，新种也是同宗配合菌，它的发现使此属的同宗配合种的比例更加提高，这在它所属的毛霉科内是很少见的。最后，形态方面新种还因接合孢子囊和接合孢子较同属其他已发现有性型的种大得多，假根异常发达和多样化，孢子枝的壁粗糙和侧枝可长达8000微米等特征而与属内所有的已知种不同。

除新种的拉丁文及英文描述外，还提供了根毛霉属全部6种 7分类群的分种和变种检索表。

Supported by the National Natural Science Foundation of China

A species of endophytic *Rhizomucor* was isolated from wheat collected on 28 February 1994 in the greenhouse of the Institute of Crop Cultivation, Chinese Academy of Agricultural Sciences, Beijing.

The wheat samples were carefully examined in our laboratory to ensure that no symptomatic infections could be found. Twenty plates were used for isolation. Healthy wheat leaves were cut down, washed with distilled water many times, and with sterile distilled water two times before submerging in 75% ethanol for 1 min., followed by 1:3 (Plates 1-7), 1:4 (Plates 8-13), and 1:5 (Plates 14-20) dilutions of water and NaClO for 5 min., and again by a 75% ethanol for 30 sec. and washed with sterile distilled water two times. The wheat leaves were then cut in pieces and placed three by three onto each of the isolation plates. Malt Extract Agar (MA, consisting 2% malt extract and 2% agar) with the addition of 50 ppm chlor-tetracycline after sterilization at 15 lbs for 20 min., was used as isolation medium. The plates were incubated at 25°C.

From three to four days onwards, abundant mycelia of several kinds were seen to grow out from the surface of many of the wheat leaves in Plates 14-20 and a few of those in Plates 8-13. The wheat leaves in Plates 1-7 remained sterile until three weeks later, mycelia were seen to grow out from the cut margin of the wheat leaves in Plate 7. This fungus was believed to be an endophyte since it grew out from the cut margin instead of the surface of the wheat leaves and did not seem likely to be a saprobe which survived surface sterilization. The mycelia from the cut margin of the leaf pieces in Plate 7 were then transferred to other MA plates for sexuality study or to Synthetic Mucor Agar (SMA, consisting dextrose 2 g, asparagine 2 g, KH_2PO_4 0.5 g, $MgSO_4 \cdot 7H_2O$ 0.25 g, thiamine chloride 0.5 mg, agar 15 g, dist. H_2O 1000 ml) plates for taxonomic study.

After growing at 25°C for four days, the mycelia filled the petri dish and turned black with the formation of numerous zygospores. When examined under the microscope, the fungus was found to be a new species of zygomycetes pertaining to the genus *Rhizomucor* of the Mucoraceae (Mucorales). The fungus is homothallic since all subcultures resulted from single-spored isolation persisted in producing numerous zygospores.

Rhizomucor endophyticus Zheng & H. Jiang sp. nov. (Figs. 1-3; Pls. I)

Coloniae ad temp. 18-28°C in SMA et PDA bene crescentes, 5-10 mm altae, Petri-patellas

in 4 diebus in SMA ad temp. 24°C implentes, incremento ad vel subter temp. 4°C et ad vel super temp. 37°C cessatae, primum albae, cito griseae ad nigropunctatas cum progressu numerosarum zygosporarum, subnigrae in adversum umbris. Hyphae ramosae, eseptatae quando juveniles, septatae in aetate, septis simplicibus, 5.0-18.5 μm diam. Stolones veri interdum praesentes. Rhizoidea maxime copiosa, e portionibus variis hypharum, stolonum vel sporophororum, raro sporangiorum vel columellarum enata, digitaliformia vel rhizomorphoidea, vesiculosa, vel irregulariter conformata, simplicia vel ramosa, septata vel eseptata, directa, curvata, conglomerata in fasces, vel intricata in globos. Sporophora erecta, ascendentia vel recumbentia, e stolonibus enata, fere rhizoideis nonoppositis, magis saepe directe e hyphis aeriis enata et stolonoidea, axibus sporophororum ad longitudine 1000 μm pervenientibus, 4.0-18.5 μm diam., plerumque aequis diam. omnino, interdum obscure attenuatis superne, vel inaequis in sporophoris aliquibus, septis 1-2 vel pluribus, frequenter praesentibus in loco ramoso, generaliter hyalina, interdum brunneola, granulata vel nongranulata, laevigata, sublaevigata ad perspicue verrucosa, simplicia, persaepe sympodice et in deinceps 1-2(-4) ramosa, raro ramis oppositis, ramis fere valde longis, 300-1500(-8000) μm in longitudine, 2.5-15.5 μm diam., plerumque cum sporangio terminatibus, aliquando sterilibus et spiniformibus. Sporangia globosa ad leniter depresso-globosa, 38.0-80.0 μm diam., non apophysata, fusca, parietibus tabidis. Columellae subglobosae, late ellipsoideae, ovoideae, vel depresso conicae, 19.0-50.5 × 18.0-46.0 μm vel 13.5-37.0 μm diam., omnino cum collaribus distinctis. Sporangiosporae anguste ad late ellipsoideae, ovoideae, subglobosae, subtriangulares, allantoideae, vel figuris irregularibus, directae vel curvatae, 3.0-16.0 × 2.0-8.0 μm vel 2.5-5.0 μm diam., hyalinae, griseolae in massis. Chlamydosporae solitariae, raro breviter catenulatae, generaliter intercalares, in massis vel intermixtae cum rhizoideis in myceliis aeriis, subglobosae, ovoideae, limoniformes vel aliae formae irregulares, 11.0-23.0 × 9.0-18.5 μm, hyalinae. Zygosporangia subglobosa, frequenter subcompressa inter suspensores, 47.0-106.0 μm diam., fusca ad nigra in maturitatem, cum processibus tuberculiformibus et obtusis. Zygosporae subglobosae, late ellipsoideae, ovoideae, 44.0-102.0 μm diam., parietibus externis praecrassis et 8 μm attingentibus, leniter crenulatis ad sublaevigatos, hyalinae, quaeque uno magno globulo oleoso praeditae. Suspensores praecipue aequales, raro inaequales, frequenter turgidi, subglobosi ad ovoideos, colligati juxta basim, 21.5-50.5 μm diam. in portionibus latissimis et 9.0-16.0(-23.0) μm diam. in portionibus basilaribus, 16.0-47.0 μm longi, frequenter graviter crustati, raro laevigati, septis generaliter absentibus, aurantio-brunnei, dilute brunnei vel hyalini. Homothallicus.

HOLOTYPUS HMAS 69204 et **ISOTYPUS** HMAS 69205 (cultura exsiccata e Rm8), isolatus e *Tritico aestivo* L. instar endophytis de Beijing a Jiang Hong, 1994.

Colonies growing well at 18-28°C on SMA and PDA, 5-10 mm high, filling the petri dish in 4 days at 25°C, development ceased at 4°C or below and at 37°C or above, at first white, soon becoming gray to blackish with the formation of numerous zygospores, reverse blackish. Hyphae branching, nonseptate when young, septate in age, with simple septa, 5.0-18.5 μm diam. Stolons sometimes present. Rhizoids very abundant, arising from various parts of the hyphae, stolons, or sporophores, rarely from the sporangia or columellae, finger-like, root-like, vesicular, or irregularly shaped, simple or branched, septate or nonseptate, straight, curved, twisted into a bundle, or in a globose tangled mass. Sporophores erect, ascending or recumbent, arising from stolons, usually with non-opposite rhizoids, or

more often arising directly from aerial hyphae and stolon-like; main axes of sporophores reaching a length of 1000 μm, 4.0-18.5 μm diam., usually equal in width throughout, sometimes indistinctly attenuated upwards, or becoming unequal in some sporophores, septa 1-2 or more, often present at the point of branching, generally colorless, sometimes brownish, with or without granular contents, smooth, subsmooth to evidently verrucose, simple, more often sympodially and successively branching 1-2(-4) times, rarely with opposite branches; branches usually very long, 300-1500(-8000) μm in length, 2.5-15.5 μm diam., mostly terminated with a sporangium, occasionally substituted by a sterile spine. Sporangia globose to depressed-globose, 38.0-80.0 μm diam., non-apophysate, wall diffluent, dark brown. Columellae subglobose, broadly ellipsoid, ovoid, or depressed-conical, 19.0-50.5 × 18.0-46.0 μm or 13.5-37.0 μm diam., light brown to subhyaline, all with a distinct collar. Sporangiospores narrowly to broadly ellipsoid, ovoid, subglobose, triangular, allantoid, or irregularly shaped, straight or curved, 3.0-16.0 × 2.0-8.0 μm or 2.5-5.0 μm diam., hyaline, grayish in mass. Chlamydospores solitary, rarely in short chain, generally intercalary, in mass or intermixed with rhizoids in aerial mycelia, subglobose, ovoid, lemoniform, or other irregular forms, 11.0-23.0 × 9.0-18.5 μm, hyaline. Zygosporangia subglobose, often slightly compressed between the suspensors, 47.0-106.0 μm diam., dark brown to black when mature, with blunt wart-like projections. Zygospores subglobose, broadly ellipsoid, ovoid, 44.0-102.0 μm diam., outer wall very thick and reaching 8 μm in thickness, slightly crenulate to subsmooth, hyaline, each with a large oil globule. Suspensors mainly equal, rarely unequal, usually inflated, subglobose to ovoid, constricted at the base, 21.5-50.5 μm diam. at the broadest part and 9.0-16.0(-23.0) μm at the basal part, 16.0-46.0 μm long, often heavily incrusted, rarely smooth, septa generally absent, orange-brown, light brown or colourless. Homothallic.

Strain studied: Isolated as an endophyte from the leaves of *Triticum aestivum* L. in the glasshouse of the Institute of Crop Cultivation, Chinese Academy of Agricultural Sciences, Beijing, by Jiang Hong, 28 February 1994. Dried cultures — HMAS 69204 (**HOLOTYPE**), HMAS 69205 (**ISOTYPE**).

Dried cultures are kept in Herbarium Mycologicum Instituti Microbiologici Academiae Sinicae (HMAS 69204, HMAS 69205), and the living cultures are deposited in the State Key Laboratory of Microbial Resources (Rm8) and AS Culture Collection (AS 3.4684), all of Institute of Microbiology, Academia Sinica, Beijing 100080, China.

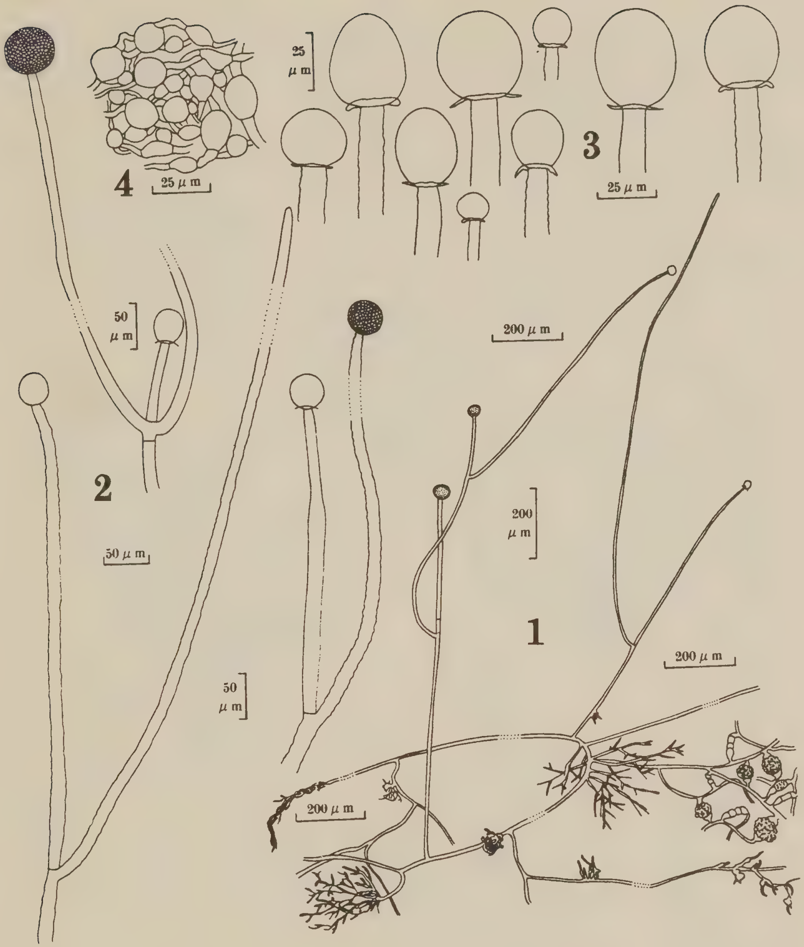


Fig. 1. *Rhizomucor endophyticus*. 1. Growing habit of the fungus. 2. Upper portion of sporophores showing general characteristics of branching. 3. Columellae of various shapes, all with distinct collar. 4. Chlamydospores on aerial hyphae, mostly solitary and intercalary.

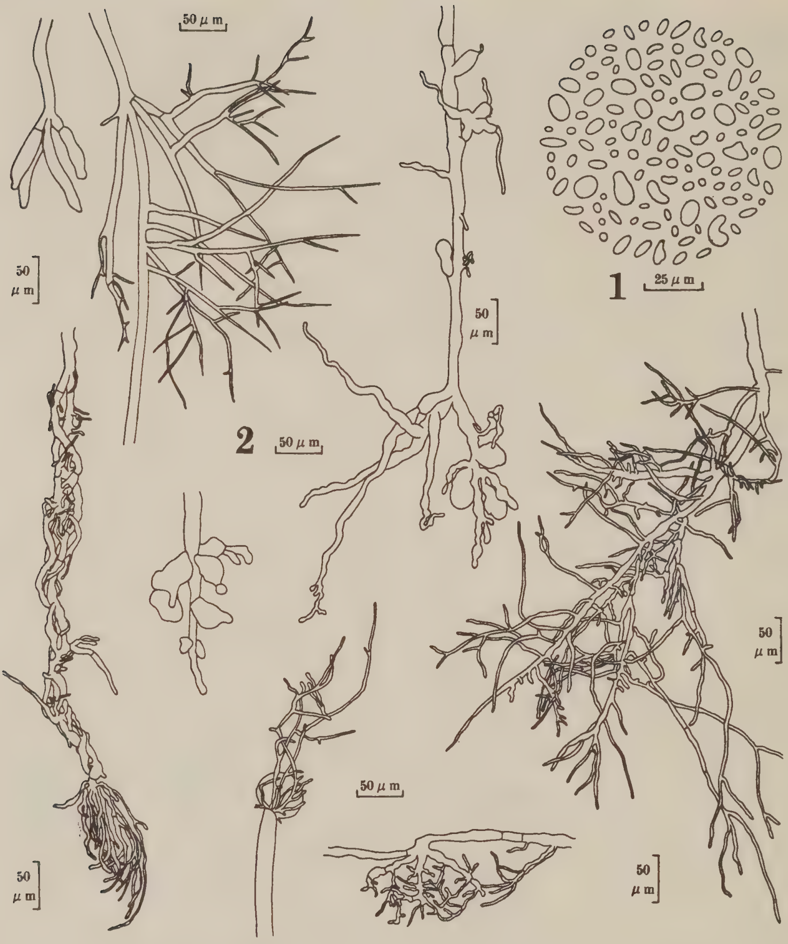


Fig. 2. *Rhizomucor endophyticus*. 1. Sporangiospores of various shapes and dimensions. 2. Rhizoids of various forms.

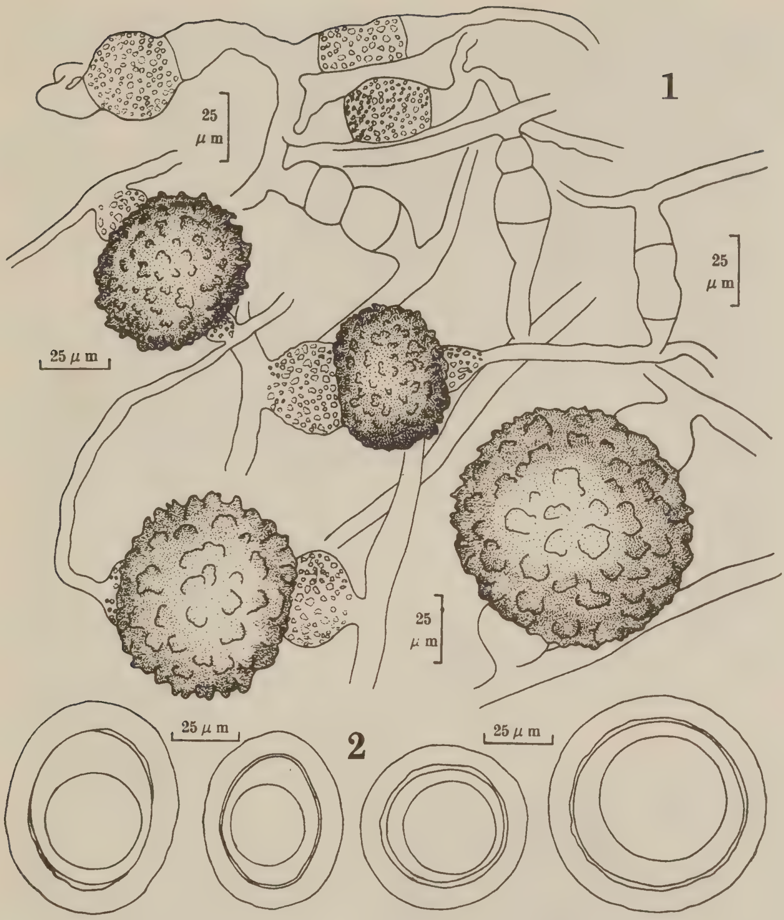
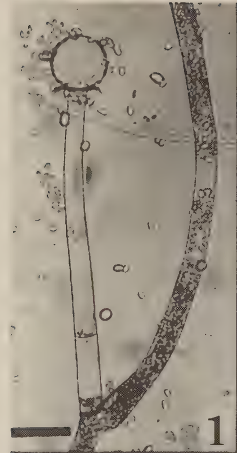


Fig. 3. *Rhizomucor endophyticus*. 1. Different stages and general characteristic of the teleomorph. The two suspensors of a zygosporangium are usually inflated and equal in shape but unequal in dimension. 2. Zygospores detached from zygosporangia, all with a large oil globule and with a very thick outer wall.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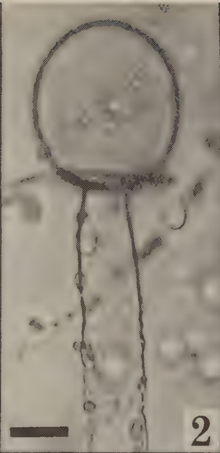
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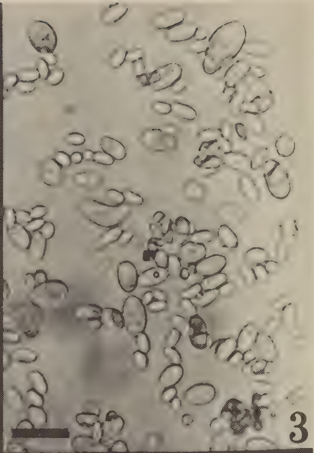
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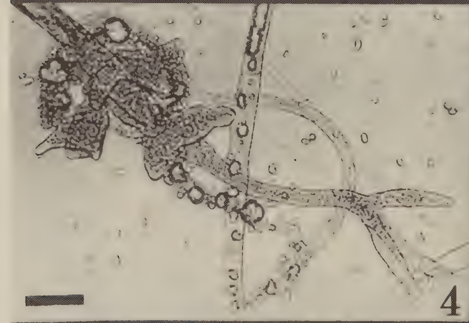
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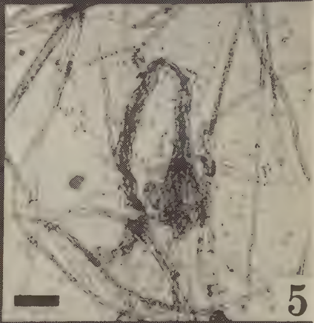
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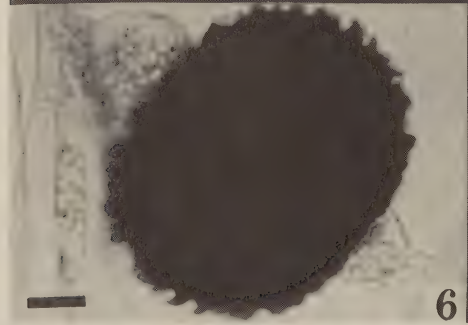
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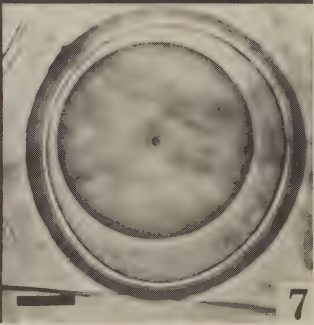
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The new species possesses many uncommon characters.

As pointed out by Petrini & Muller (1986), the most frequently isolated endophytes are the deuteromycetes, whereas ascomycetes and very few basidiomycetes and oomycetes have also been reported. Endophytic zygomycetes seem to be rare and only members of the Mucorales have been reported so far. *Mortierella vinacea* Dixon Stewart from fruticose lichens (Petrini *et al.*, 1990), *Absidia cylindrospora* Hagem, and *Mortierella* spp. from bracken (Petrini *et al.*, 1993) are few of the examples. Endophytic zygomycetes from higher plants seem to be even rarer, however, Petrini (personal communication) stated that Fisher and himself have occasionally isolated Mucorales, particularly *Rhizopus*, as endophytes of higher plants. Discovery of *Rhizomucor endophyticus* in wheat has shown that more zygomycetes might be expected to be found as endophytes from higher plants.

In *Rhizomucor*, all taxa have been reported to be thermophilic until *Rhizomucor variabilis* Zheng & G.-q. Chen var. *variabilis* and *Rhizomucor variabilis* var. *regularior* Zheng & G.-q. Chen were found. The optimum, maximum, and minimum growth temperatures of these two varieties are the same, i.e. 24-30°C, 38°C, and 9°C respectively (Zheng & Chen, 1991, 1993), while in *Rhizomucor endophyticus*, the optimum, maximum, and minimum growth temperatures are even lower, being 18-28°C, 36°C, and 5°C respectively.

Excepting *Zygorhynchus*, in which all species are homothallic, and *Dicranophora*, with only one homothallic species, homothallic taxa are rare and constitute only a low percentage in most of the other genera of the Mucoraceae; with nearly all of them, heterothallism is the prevailing sexual form. In the five known species of *Rhizomucor, Rhizomucor miehei* (Cooney

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Pl. I. *Rhizomucor endophyticus*. 1. Terminal portion of a sporophore showing typical type of branching and septa formed at and above the point of branching (bar=50μm). 2. Upper portion of a sporophore with verrucose wall (bar=20μm). 3. Sporangiospores (bar=20μm). 4. Rhizoids which are vesicular and originating from the stolon (bar=50μm). 5. Rhizoids which are twisted into a bundle and originating from the hypha (bar=100μm). 6. A zygosporangium with two suspensors equal in shape but unequal in dimension (bar=20μm). 7. A zygospore with very thick wall and a large oil globule (bar=20μm).

& Emerson) Schipper and *Rhizomucor nainitalensis* Joshi have been described as homothallic; in addition, *Rhizomucor pusillus* (Lindt) Schipper is also known to have a few homothallic strains (Smith, 1957; Schipper, 1969, 1978), this makes the proportion of homothallic species remarkably high in this genus. With *Rhizomucor endophyticus*, homothallic species in *Rhizomucor* now amount to over 50%, which is exceptionally high in the Mucoraceae.

Morphologically, the new species can be distinguished from the other taxa in the same genus by possessing: (1) Zygosporangia and zygospores which are much larger in dimension than those of the other species with known teleomorphic state; (2) Rhizoids which are richly developed and of various forms; (3) Sporophores which are usually verrucose and with very long side branches reaching a length of 8000 μm. A key to all the recognizable taxa in the genus is presented here.

KEY TO THE SPECIES AND VARIETIES OF *RHIZOMUCOR*

1. Non-thermophilic, maximum temperature for growth 36°C or 38°C; rhizoids well developed; collar evident; zygospores, when formed, reaching 100 μm in diam. 2

1. Thermophilic, maximum temperature for growth 48°C or more; rhizoid poor; collar absent; zygospores when formed not exceeding 70 μm in diam...4

2. Homothallic; colonies dark gray to blackish owing to the formation of numerous zygospores; optimum, maximum, and minimum temperatures for growth 18-28°C, 36°C, and 5°C respectively; branches of the sporophores usually very long, 300-1500(-8000) μm in length, occasionally non-fertile and substituted by a sterile spine; columellae regular in shape; endophytic in higher plants ....***Rhizomucor endophyticus***

2. Heterothallic; colonies bright yellow; optimum, maximum, and minimum temperatures for growth 24-30°C, 38°C, and 9°C respectively; branches of the sporophores usually shorter, not exceeding 2500 μm in length, usually fertile and terminated by a sporangium; columellae very irregular in shape; causing human primary cutaneous mucormycosis 3

3. Rhizoids arising from stolons, aerial mycelia, sporophores, sporangia, or columellae; septa usually not present on sporophores, if present, not definite in position; irregularly shaped columellae found in young cultures; apophyses absent or present; sporangiospores very irregular in shape ....***Rhizomucor variabilis*** var. ***variabilis***

3. Rhizoids arising from stolons and aerial mycelia only and not from sporophores, sporangia or columellae; septa usually present at the point of sporophore branching; irregularly shaped columellae can found only in 10 day old cultures; apophyses always absent; sporangiospores quite regular in shape ....***Rhizomucor variabilis*** var. ***regularior***
4. Maximum temperature for growth 48°C; colonies light gray to grayish yellow; sporangiospores irregular in shape ..***Rhizomucor nainitalensis***
4. Maximum temperature for growth 56-57°C; colonies dark gray; sporangiospores regular in shape 5
5. Sporophores swollen, reaching a diameter of 35 μm; sporangia reaching 125 μm diam. ....***Rhizomucor tauricus***
5. Sporophores not swollen, not exceeding 15 μm diam.; sporangia usually not exceeding 100 μm diam. 6
6. Sporangia reaching 100 μm diam.; zygosporangia up to 70 μm diam.; usually heterothallic, but also rarely homothallic ....
....***Rhizomucor pusillus***
6. Sporangia reaching 60 μm diam.; zygosporangia not exceeding 50 μm diam.; homothallic ....***Rhizomucor miehei***

ACKNOWLEDGEMENTS

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MYCOTAXON

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LIGNICOLOUS APHYLLOPHORALES (BASIDIOMYCETES) ON GREEK JUNIPER (JUNIPERUS EXCELSA) IN THE REPUBLIC OF MACEDONIA

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Lignicolous Aphyllophorales on *Juniperus excelsa* were studied in the territory of the R.Macedonia on 6 localities where the associations of Greek Juniper is best developed. Together with a few species established before, there are now 24 known species occurring on wood of this juniper. As particularly interesting can be mentioned *Antrodia juniperina, Hyphodontia juniperi, Hyphoderma pallidum, Peniophora junipericola* and *Pyrofomes demidoffii.*

INTRODUCTION

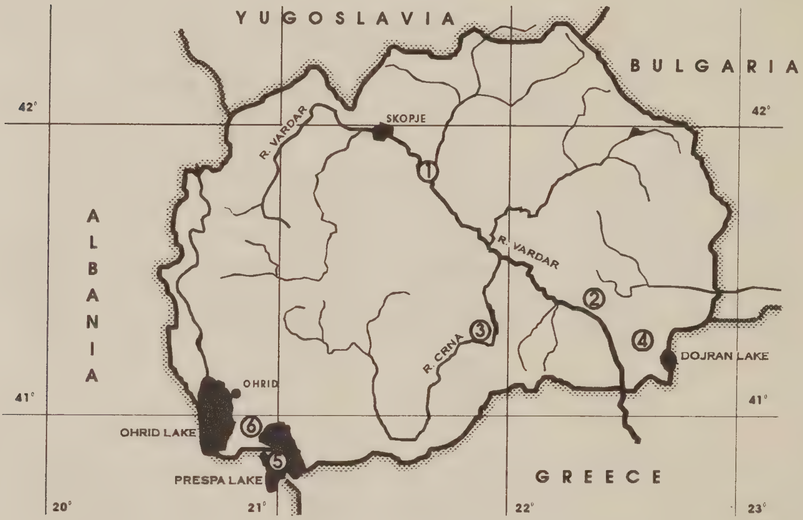
The Greek or Crimean Juniper (*Juniperus excelsa* M.Bieb.) is an evergreen tree of a middle height (15-20 m) with a pyramidal dark-green crown and scale-like leaves. The area of distribution reaches from Iran through Asia Minor, Crimea up to Balkan Peninsula (Bulgaria, Greece, Macedonia). In Macedonia it is distributed in several localities along the river Vardar and some of its tributaries, as well as in the region of the lake Prespa. It occurs in xerothermic sites, most frequently on limestone, diabase or serpentine, and often forms rather small, almost pure associations, not higher than 1100 m alt.

The Greek Juniper forms two associations in Macedonia: *Pruno webbii-Juniperetum excelsae* Em (57)62 and *Juniperetum excelsae-foetidissimae* Em 65. Investigations were carried out in the former which is the most frequent and the mostly spread one. *Juniperus excelsa* is dominant and *Carpinus orientalis, Phillyrea media, Prunus webbii* and *Celtis glabrata* (this one only on the islet Golem Grad) are admixed.

Only two species growing on wood of this juniper were published up to now (Pilát 1937, 1936-42, Koleva-Šekutkovska 1959, Tortić 1987,1988). The results of the further investigations were presented at The Forth International Mycological Congress in Regensburg (Germany).

MATERIALS AND METHODS

Investigations of lignicolous fungi on *J. excelsa* were carried out in all the localities in the R. Macedonia where its associations are best developed. The majority of these localities are in the Mountain Galičica (on the Prespa slope), the islet Golem Grad and in the gorges of the river Vardar and some of its tributaries (vicinity of Valandovo, Demir Kapija, and Katlanovo, as well as in the Tikvesh Gorge of the river Crna).



Localization of the study areas in the Republic of Macedonia:
1 - Katlanovo, 2 - Demir Kapija, 3 - Tikvesh Gorge,
4 - Valandovo, 5 - Islet Golem Grad, 6 - Galičica Mt.

The investigated forests of *J. excelsa* reach there from 150 m (Demir Kapija and Valandovo) to about 1000 m altitude (Galičica). The most intensively investigated area were the islet Golem Grad in the Prespa Lake (EL02) and the Prespa slope of the mountain Galičica (DL92) where the association of *J. excelsa* is older, purer and better developed than anywhere else. The other localities are: Katlanovo (the mouth of the river Pčinja flowing into the r. Vardar - EM53), where the association is old and well developed on rough ground; Valandovo (the vicinity of the village Chalakli - FL37) with a rather damaged forest because of the human misuse and negligence; Demir Kapija (between the gorge and the village Udovo - FL18) with single and older trunks of *J.excelsa* mixed with psudomaquis species and the Tikvesh Gorge on the river Crna (on the west side of Tikvesh Dam - EL77) where old trunks were found singly. The land there is rather inaccessible, therefore it was less investigated and moreover only in summer period which is unfavorable for the growth of fungal fruitbodies.

Investigations of unequal intensity were carried out in the period of 1989-1992. Most finds were made in spring and autumn; summer is very hot and dry and few species are developed. The specimens are preserved in the private herbarium of the author.

LIST OF SPECIES

AMYLOSTEREUM LAEVIGATUM (Fr.) Boid.
ANTRODIA JUNIPERINA (Murril) Niemelä & Ryv.
ATHELIA NEUHOFII (Bres.) Donk
BYSSOMERULIUS HIRTELLUS (Burt.) Parm.
GLOEOCYSTIDIELLUM LURIDUM (Bres.) Boid.
GLOEOPHYLLUM ABIETINUM (Pers.: Fr.) Murr.
HYMENOCHAETE FULIGINOSA (Pers.) Bres.
HYPHODERMA PALLIDUM (Bres.) Donk
HYPHODONTIA ARGUTA (Fr.) John Erikss.
HYPHODONTIA JUNIPERI (Bourd.et Galz.) Erikss.et Hjortst.
PENIOPHORA JUNIPERICOLA J.Erikss.
PHELLINUS FERRUGINOSUS (Schrad.: Fr.) Pat.
PYROFOMES DEMIDOFFII (Lév.) Kotl.& Pouz.
RADULOMYCES RICKII (Bres.) M.P.Christ.
SCYTINOSTROMA ALUTA Lanquetin
STECCHERINUM LITSCHAUERI (Bourd.& Galz.) J.Erikss.
STEREUM HIRSUTUM (Willd.) Pers.
SUBULICYSTIDIUM LONGISPORUM (Pat.) Parm.
TRECHISPORA FARINACEA (Fr.) Liberta
TUBULICRINIS CALOTHRIX (Pat.) Donk
TUBULICRINIS GRACILIMUS (Rog.& Jacks.) G.H.Cunn.
TUBULICRINIS MEDIUS (Bourd.& Galz.) Parm.
TUBULICRINIS SORORIUS (Bourd.& Galz.) Oberw.
VESICULOMYCES CITRINUS (Pers.) Hagström

DISCUSSION

All the 24 lignicolous macromycetes on *Juniperus excelsa* known up to now belong to *Aphyllophorales.* Only two species, *Hyphodontia juniperi* collected 1936 by V.Lindtner in the region of Poreće - Central Macedonia (Tortić 1988) and *Pyrofomes demidoffii* collected from Katlanovo Koleva-Šekutkovska 1959) in Galičica Mt. (Tortić 1987) were published earlier.

The most frequent species were: *Antrodia juniperina, Hyphodontia juniperi* and *Pyrofomes demidoffii,* found in larger or smaller quantities in all the localities investigated during almost every visit.

Somewhat less frequent were: *Amylostereum laevigatum, Gloeophyllum abietinum, Hymenochaete fulliginosa, Hyphodontia arguta, Peniophora junipericola, Phellinus ferruginosus* and *Radulomyces rickii.*

Rare, some found only once or twice were: *Athelia neuhofii, Gloeocystidiellum luridum, Hyphoderma pallidum, Byssomerulius hirtellus, Scytinostroma aluta, Steccherinum litschaueri, Stereum hirsutum, Subulicystidium longisporum, Trechispora farinacea, Tubulicrinis calothrix, T.gracilimus, T.medius, T.sororius* and *Vesiculomyces citrinus;* a number of them belongs to rather frequent species in Macedonia and in other countries.

Several fungi grow predominantly or exclusively on various species of the genus *Juniperus*, as *Amylostereum laevigatum, Antrodia juniperina, Hyphodontia juniperi, Peniophora junipericola* and *Pyrofomes demidoffii,* while *Gloeophyllum abietinum, Hymenochaete fulliginosa, Hyphoderma pallidum* and *Vesiculomyces citrinus* are typical for conifers. The rest of the species grow on conifers as well as on deciduous trees and shrubs.

Particularly interesting are *Antrodia juniperina, Hyphodontia juniperi, Pyrofomes demidoffii, Peniophora junipericola* and *Hyphoderma pallidum.* Their distribution and hosts are here discussed.

Antrodia juniperina is known in East Africa (Ethiopia, Kenya and Tanzania) as a parasite and saprophyte on thick trunks of *Juniperus procera* (Niemelä & Ryvarden 1975). In the USA it grows on *Juniperus deppeana, J.monosperma, J.osteosperma* and *J.virginiana* (Gilbertson & Ryvarden 1986), and in Europe only in Spain on *Juniperus thurifera* (Garcia-Manjon & Moreno 1981) and Bulgaria on *Juniperus excelsa* (Ryvarden & Gilbertson 1993). This species is frequent in all the investigated localities and grows as a saprophyte, rarely as a parasite on old trunks of *J.excelsa.*

Hyphoderma pallidum is a rare species preferring conifers. According to Lecot (1984) in France it grows on *Cupressus macrocarpa*, in Spain on *Pinus silvestris* (Telleria & Truchero), in Portugal on *Pinus* (Melo & Cardoso 1985) and in Austria on *Castanea, Pinus* etc. (Hallenberg & Mitschelitsch 1982-83). In Scandinavia it grows on conifers: *Juniperus communis, Picea abies* and *Pinus silvestris*, but also on *Alnus* (Eriksson & Ryvarden 1975). In Former Yugoslavia this species is known from two localities, in Plitvice

(Croatia) on *Picea* and *Abies* (Tortić 1985) and in Trnovo near Sarajevo on *Picea* (M.Tortić - personal communication). In Macedonia it was collected only once on the islet Golem Grad on a dead branch of *J.excelsa*.

Hyphodontia juniperi grows chiefly on dead branches of *Juniperus spp.*, but it also occurs on deciduous trees. In the north of Europe it has been collected only in Sweden. Bourdot and Galzin found it to be a frequently occurring species on *Juniperus* in Central France, where it was collected on *Pyrus* and *Robinia*. It also occurs on Crete on *Cupressus*, in Spain on *Juniperus* and in Iran on *Buxus* (Eriksson, Hjortstam & Ryvarden 1981). According to M.Tortić (personal communications) in Former Yugoslavia (Slovenia and Croatia) it occurs on several localities where it grows on *Abies*, *Clematis*, *Taxus* and *Juniperus communis*. There are two localities in Macedonia: on the mountain Jakupica on *Carpinus betulus* and in Poreče on *J.excelsa* (Tortić 1988).

This species is frequent in all the investigated localities, occurring as a saprophyte on dead branches of the Greek juniper. According to the finds up to now, it prefers dry and warm areas with high temperatures showing a thermophilous character.

Peniophora junipericola occurs on dead, still attached branches of *Juniperus spp*. In Sweden, France and Estonia was collected on *Juniperus communis* (Eriksson & al. 1981); in Spain on *Juniperus oxycedrus* (Garcia-Manjon & Moreno 1981). It was collected in many localities in Macedonia, particularly on the mountain Galičica and on the islet Golem Grad on *Juniperus oxycedrus* and *J.excelsa*.

Pyrofomes demidoffii is a dangerous parasite of various *Juniperus spp.* in East Africa (Ryvarden & Johansen 1980) and is also frequent on species of this genus in North America (Gilbertson & Ryvarden 1987). Bondartsev (1971) mentions its finds in Caucasus, Uzbekistan, Siberia, Crimea, mostly on *Juniperus spp.*, but also on *Cupressus* and *Pinus*. He considers it to be a subtropical species. It also occurs in Bulgaria on *Juniperus excelsa* (Ryvarden & Gilbertson 1993). For Macedonia it was published by Pilát (1937, 1936-42) from the vicinity of the lake Ohrid on *Cupressus sempervirens*. Later it was reported by Koleva-Šekutkovska (1959) from Katlanovo on *Juniperus excelsa*, and recently it was collected at lake Prespa, also on *Juniperus excelsa* (Tortić 1987). Ryvarden (1991) has made a map of distribution of *P.demidoffii* in the world.

This species is frequent on all the investigated areas of Greek juniper in Macedonia. It is a parasite on old trunks and causes considerable damages in juniper associations. It is particularly frequent in the vicinity of Katlanovo where about 30% of *J.excelsa* is infected by this parasite. In the vicinity of the lake Ohrid, on Cupressus, this species was not found repeated.

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A NEW SPECIES OF HYPHODONTIELLA

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Hyphodontiella hauerslevii nov. sp. is described and illustrated. Its inclusion in the originally monotypic genus *Hyphodontiella* Strid is discussed. The limits of the genus is changed to include also cystidiate species and a variable occurrence of clamp-connexions on the generative hyphae.

During an investigation of a moist, deciduous forest within the town of Alingsås we came upon a stand of *Athyrium filix-femina* where dead stipes were overgrown by a corticiaceous fungus unknown to us. It soon became clear that the material corresponded with other unnamed specimens in our herbarium collected by K. Hauerslev from Denmark, by T. Nakken from Norway and by ourselves. None of these earlier specimens were rich enough to permit a complete description and thus the species had remained unpublished.

Measurements and drawings are made from preparations of fresh material in cotton blue in lactic acid.

Hyphodontiella hauerslevii K.H. Larss. & Hjortstam nov. sp.

Basidioma resupinatum, tenue, arte adnatum, sed substrato facile separabili. Hymenium album, leve, minute caespitosum. Systema hyphale monomiticum. Subiculum inconspicuum, hyphis paucis, strictis, brevi-cellularis, 2–3(–5) µm latis, hyphae ceteri similiter, ramificationibus ad angulum 90 patentes. Hyphae subiculae totae efibulatae. Cystidia numerosa, tenuitunicata, supra basidia projecta, 70–100 × 5–6(–8) µm. Basidia primo clavata, tum subcylindrica, leviter constricta, 12–15(–20) × 4–5 µm, (1–)2-4 sterigmatibus, fibulis ansoidibus. Sporae leves, tenuitunicatae, anguste ellipticae vel subfusiformes, 6–7(–8) × 2.5–3 µm, nec amyloideae, nec dextrinoideae, neque cyanophilae.

Holotypus: SWEDEN. Västergötland. Alingsås, Nolhaga, near Tallhyddan, on *Athyrium filix-femina* and debris. 14 Oct 1994. K. Hjortstam and K.H. Larsson KHL 8420 (GB).

Etymology: The species is named in honour of the eminent Danish mycologist K. Hauerslev, who made the first records of the new species.

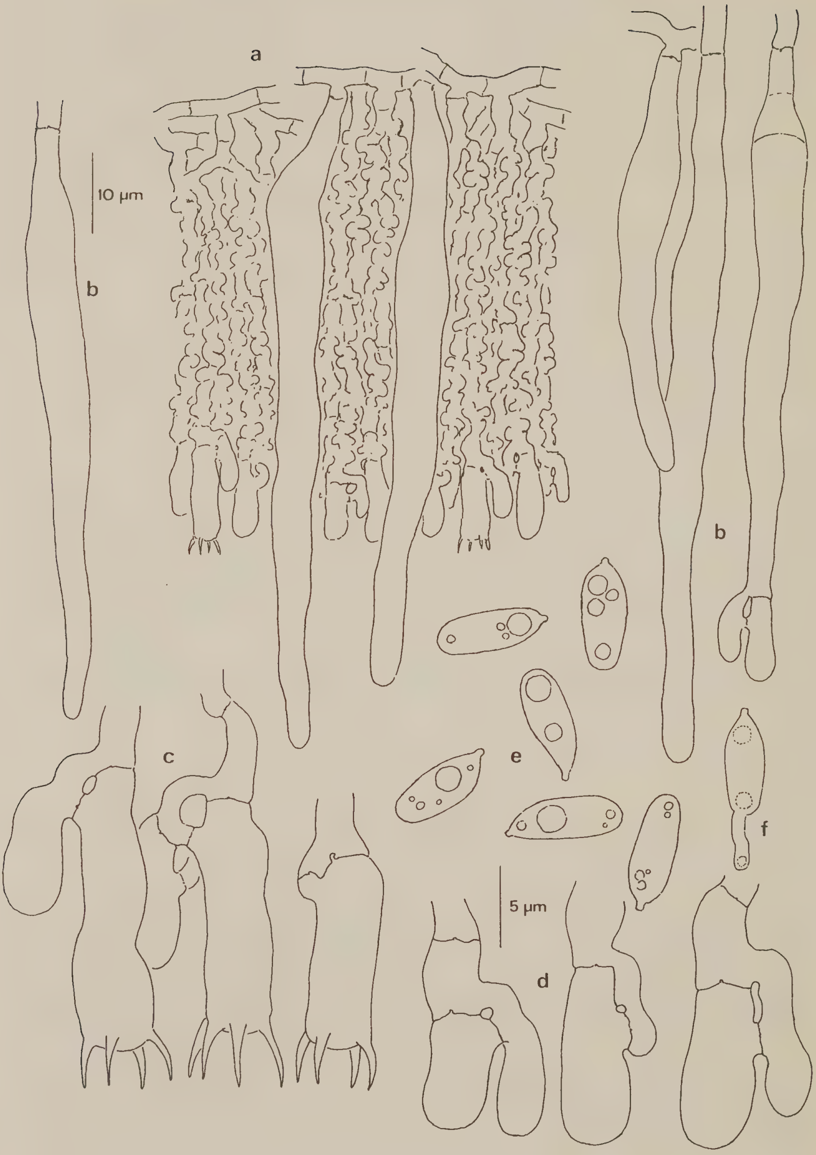

Fig. 1. *Hyphodontiella hauerslevii.* a) section through basidiome b) cystidia c) basidia d) immature basidia e) spores f) germinating spore. Type.

Basidiome effused, closely adnate but easily separable from the substratum, thin, white; margin not differentiated. Hymenophore smooth, from the beginning discontinuous and strongly porulose to minutely tufted, with age and in fresh condition almost closed but, when dried, again porulose.

Hyphal system monomitic, all hyphae thin-walled. Subiculum consisting of a few, straight, sparsely branched, 3–5 µm wide, simple-septate hyphae and of a thin layer of moderately branched, loosely interwoven 2–3 µm wide, also simple-septate hyphae with fairly short cells. Hyphal branching at right angles, occurring both at septa and between two septa, the new branch often with a constriction at the branching point. Subhymenium up to 70 µm thick, with a dense texture of hyphae and collapsed basidia that make it difficult to discern individual hyphae; hyphae short-celled, somewhat irregular and torulose, 1.5–4 µm wide. They are seemingly simple-septate but this is very difficult to verify.

Cystidia abundant, thin-walled and with smooth to finely grainy contents; arising from subicular hyphae and usually protruding above the basidia, 70–100 × 5–6(–8) µm, usually widest in the lower part; apex 3–4 µm wide, often with one, rarely several, adventitious septa near the base.

Basidia at first clavate then cylindrical, sometimes with a slight median constriction, 12–15(–20) × 4–5 µm, with (1–)2–4 slender, slightly curved, 3.5 µm long sterigmata; basally with a more or less ansiform clamp-connexion.

Spores smooth, thin-walled, narrowly elliptical to subfusiform, broadest near the hilar appendage, with oily protoplasm, 6–6.7(–8) × 2.5–3 µm (mean values in type collection, n = 30, 6.41 × 2.65, l/w = 2,4). Spores from 1-2-spored basidia are generally somewhat larger and usually measure 8–10 × 3–3.5 µm.

Habitat and ecology. The type collection grew on putrescent stipes of *Athyrium filix-femina* and occasionally on thin branches and leaves of deciduous trees. Other known collections are all growing on small wood pieces, presumably from deciduous trees. Hauerslev (herbarium notations) reports *Salix sp, Sambucus nigra* and *Crataegus sp* as substrates from Denmark. The type locality is a small moist to wet deciduous forest. It is situated close to lake Mjörn and is seasonally flooded by the lake, especially in spring-time. Dominating trees are *Alnus glutinosa, Salix spp, Betula spp, Fraxinus excelsior* and *Prunus padus*. At dryer places also some *Quercus robur* occur. The forest floor is covered by grasses, sedges and herbs that are typical of moist woodland, meadows and riverside vegetation.

The Omberg collection is from a brook and the Norwegian collection is close to a rivulet. It seems that this species prefer wet places and may even need occasional submerged conditions for growth or for spreading.

Distribution. So far known only from Denmark, Sweden and Norway.

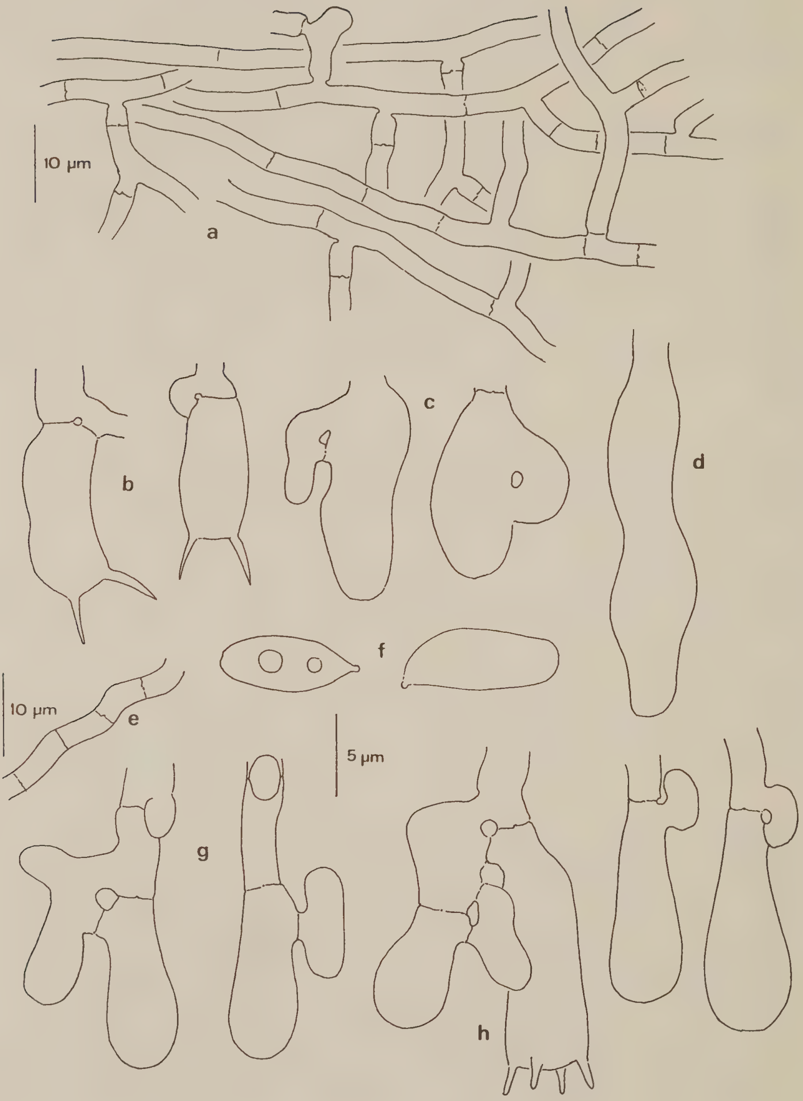

Fig. 2. a) *Hyphodontiella hauerslevii.* Subicular hyphae. Type — b–f. *H. hauerslevii.* Details from two-sterigmate basidiome b) basidia c) immature basidia d) cystidium e) fragment of subicular hypha f) spores. Nakken 2588 — g–h. *H. multiseptata.* g) immature basidia h) basidium. K.H. Larsson 7130 (GB).

Additional material examined. DENMARK. Sjælland. Örholm, on *Salix sp.* 21 May 1967. K. Hauerslev 2726 (C); ibid., on *Salix sp.* 5 June 1967. K. Hauerslev 2728 (C); ibid. 24 July 1967. K. Hauerslev 2753 (C); ibid. 11 Nov. 1969. K. Hauerslev 2889 (C); ibid. 17 June 1970. K. Hauerslev 3632 (C) — Sjælland. Sorgenfri, on *Crataegus sp.* 10 June 1967. K. Hauerslev 2731 (C). NORWAY. Akershus. Baerum, Sandvikselven, Wøyen, on deciduous wood. 8 Nov. 1977. T. Nakken 2588 (GB). SWEDEN. Västergötland. Alingsås, Nolhaga, near Tallhyddan, on *Athyrium filix-femina.* 13 Oct. 1994. K. Hjortstam 17540 - Östergötland. V. Tollstad, Omberg, Storpissan, on *Alnus sp.* 23 Sep. 1983 K. Hjortstam and K.H. Larsson Hjm 13911 (GB).

The genus *Hyphodontiella* (Strid 1975) was describd with only one species, *H. multiseptata* Strid. Its unique characters are the presence of numerous unclamped septa at subicular hyphae and an unusual spore morphology (Eriksson & Ryvarden 1976). The inclusion of *H. hauerslevii* imposes some changes on the limits of the genus as it was first outlined. In the genus description basal hyphae were said to have thickened walls but in the species described here hyphae are everywhere thin-walled. Subhymenial hyphae were said to be clamped in *H. multiseptata* but in *H. hauerslevii* they are clamp-less. The genus is described as lacking cystidia but the new species has conspicuous cystidia. None of these differences implies any drastic shift in the scope of the genus but gives, what concerns clamp-connexions, a better understanding of the true nature of the clamp-less septa in *H. multiseptata.* These septa are probably not, as was said in the protologue, adventitious but true, doliporous septa. The presence of clamp-connexions is a variable feature in both species but with different patterns.

The branching of the basal hyphae has one characteristic that gives a striking resemblance to *Hyphodontia.* Hyphae branching off at more or less right angles are noticably constricted close to the branching point. This feature is most pronounced in *H. multiseptata,* probably because of its thicker cell walls.

The basidial clamp in both species is often loop-like and almost invariably involves a second, basidiole-like cell which further development is unclear. It seems that the clamp-formation is delayed and that the apical cell developes almost to a mature basidium before the clamp-connexion is closed. Unfinished clamp-connexions are seen as hooks on young basidia. This ansiform nature of basidial clamps is most prominent in *H. hauerslevii* but can be seen also in *H. multseptata,* though neither discussed by Strid (1975) nor by Eriksson and Ryvarden (1976). Typical ansiform clamp-connexions occur in *Paullicorticium ansatum* Liberta and proliferating clamp-connexions have been described by Rogers (1936) in a species of *Sebacina.*

The two species have similarities in their ecology. *H. multiseptata* has several times been collected in moist forests where flooding is not uncommon. It seems to grow on a diversity of substrates and is occasionally collected on fern remains. However, it has also a place in subalpine stands of *Betula tortuosa* and *Salix spp* (Hjortstam and Johannesen 1981).

The presence of two-sterigmate specimens of *H. hauerslevii* could be a taxonomical problem, but considering the variable occurrance of clamp-connexions, a variation in number of sterigmata is not unexpected. We have choosen not to make number of sterigmata a species delimiting character since there is a full agreement among other characteristics. Also, collections with two sterigmata are invariably very meager and with tiny basidiomata which could indicate that such individuals are haploid.

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TWO NEW SPECIES OF ONCOPODIELLA FROM HUNGARY

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SUMMARY

Notes on three species of *Oncopodiella* collected in Hungary are presented. *O. hungarica* sp. nov. and *O. robusta* sp. nov. are described and illustrated. Additional records are provided for *O. trigonella*.

During investigations of wood-inhabiting Hyphomycetes in Hungary two species of the genus *Oncopodiella* were found, which appear to be undescribed. Attempts to obtain pure cultures were unsuccessful. The morphological description is based on characteristics observed on natural substrata.

Oncopodiella hungarica sp. nov. (Fig.1. A)

Coloniae effusae, atrobrunneae, inconspicuae. Conidiophora macronemata, mononemata, simplicia, septata, subhyalina vel pallide fusca, usque 10-20 μm longa et 2-3 μm lata. Cellulae conidiogenae polyblasticae, terminales, sympodiales, cylindricae, denticulatae. Conidia acrogena, solitaria, ellipsoidea, muriformia, corniculata, brunnea, 20-30 x 9-15 μm, 2-3 cornua brevia remanentia hyalina, 2-4 μm longa.

Holotypus: Hungaria, Comitatus Győr-Sopron, pr. pag. Lipót; in ligno putrido; 1.VIII.1992, leg. Á. Révay et J. Gönczöl (BP 674 Fn.).

Colonies effuse, blackish brown, inconspicuous. Conidiophores macronematous, mononematous, unbranched, septate, subhyaline to pale brown, mainly 10-20 μm long, 2-3 μm thick. Conidiogenous cells polyblastic, terminal, sympodial, cylindrical, denticulate. Conidia acrogenous, solytary, ellipsoid, muriform, corniculate, brown, 20-30 x 9-15 μm, the 2-3 short horns remaining hyaline, 2-4 μm long.

On dead wood.

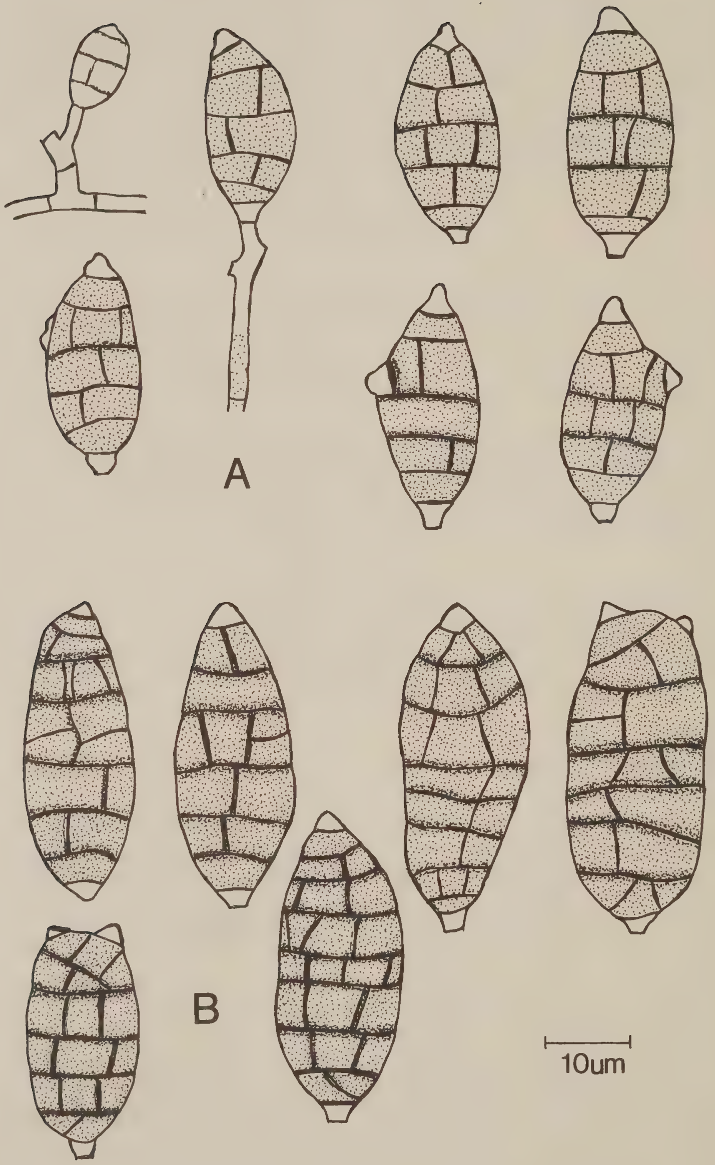

Fig. 1. (A) *Oncopodiella hungarica* (B) *Oncopodiella robusta*

Additional material studied: Hungary, Comit. Pest, near Dunabogdány; on dead wood; 8.IX.1993, Á. Révay and J. Gönczöl (BP 88374).

Oncopodiella robusta sp.nov. (Fig.1. B)

Coloniae effusae, brunneae, inconspicuae. Conidiophora macronemata, mononemata, simplicia, septata, subhyalina vel pallide fusca, usque 10-28 μm longa et 2-3 μm lata. Cellulae conidiogenae polyblasticae, terminales, sympodiales, cylindricae, denticulatae. Conidia acrogena, solitaria, late ellipsoidea, muriformia, corniculata, brunnea, 27-40 x 12-16 μm, 3 cornua brevia remanentia hyalina, 2-3 μm longa.

Holotypus: Hungaria, montes Börzsöny-hegység, pr. pag. Kismaros, ad rivulum Morgó-patak; ad ramum putr. *Alni glutinosae*; 29.IX. 1990, leg. Á. Révay (BP 675 Fn.).

Colonies effuse, brown, inconspicuous. Conidiophores macronematous, mononematous, unbranched, septate, subhyaline to pale brown, mainly 10-28 μm long, 2-3 μm thick. Conidiogenous cells polyblastic, terminal, sympodial, cylindrical, denticulate. Conidia acrogenous, solytary, broadly ellipsoid, muriform, corniculate, brown, 27-40 x 12-16 μm, the 3 short horns remaining hyaline, 2-3 μm long.

On dead twigs of *Alnus glutinosa*.

Oncopodiella trigonella (Sacc.) Rifai, Persoonia 3: 409 (1965).
Oncopodiella tetraedrica Arnaud, Bull. trimest. Soc. mycol. Fr. 69: 296 (1954).

This easily recognizable species was reported earlier from Hungary by Gönczöl & Tóth (1974) and Révay (1986) as a rare element of the Hungarian mycoflora. Subsequently this species has been collected several times and altogether 33 collections of *O. trigonella* are known from Hungary. It is interesting to note that *O. trigonella* on 17 occasions was found on stems of *Fumana procumbens* from a total of 12 different localities (unpublished). Its frequent occurrence on *Fumana procumbens* perhaps indicates that this substratum is one which is readily colonized by *O. trigonella*. Despite of its common occurrence in Hungary it is scanty recorded in the world literature. Kirk (1983) reported *O. trigonella* from the British Isles as a rare species which is represented in herb. IMI by only four collections.

Oncopodiella Arnaud ex Rifai is a small genus containing up to the present time four species. The previously monotypic genus was based on *Oncopodiella trigonella* (Sacc.) Rifai. Subsequently, the following 3 additional species of *Oncopodiella* have been described: *O. hyperparasitica* D. Hawksw. (Hawksworth & Punithalingam, 1975), *O. guamensis* Matsushima (1981), *O. cubensis* G. Arnold & Castaneda (1986).

The two species described here can easily be included in the genus *Oncopodiella* on the basis of the morphology of conidiogenous cell and conidia. Of the two new species, *O. robusta* shows some affinities with *O. cubensis* but differs in its narrower conidia with less variable septation and in the arrangement of the horns.

O. hungarica is somewhat similar to *O. robusta* but differs from it by its much smaller conidia.

Acknowledgements

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CHARACTERIZATION OF TWO PHYTOPHTHORA SPP. ISOLATED FROM KALE AND TYFON

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Species identification of two isolates of *Phytophthora* from roots of Kale (*Brassica oleracea* L.) and tyfon [*Brassica rapa* L. x *Brassica pekinensis* (Lour.) Rupr.] are herein described. Morphological and pathological characteristics as well as cardinal temperatures for mycelial growth of these isolates were compared to Australian and Great Britain isolates of *P. megasperma* from *Brassica* spp., Wyoming isolates of *P. megasperma* f. sp. *medicaginis* from alfalfa (*Medicago sativa* L.) and *P. cryptogea* from sugar beet (*Beta vulgaris* L.).

Key words: *Phytophthora, Brassica,* Taxonomy

The *Phytophthora megasperma* group exhibits diverse morphological and pathological variability. Nomenclature problems, concerning oogonial size and host specificity, have been addressed for this group (Erwin, 1983; Hansen and Maxwell, 1991; Stamps, Waterhouse, Newhook and Hall, 1990).

In most previous reports, concerning *Phytophthora* spp. pathogenic to species of *Brassica*, the pathogen has been placed in the *P. megasperma* group (Tompkins et al., 1936; Jones, 1952; Robertson and Ogilvie, 1953; Downes and Laughnane, 1969; Cvjetkovic et al., 1983; Kontaxis and Rubatzky, 1983; Hamm and Koepsell, 1984). One exception, however, was the reported attack of cabbage (*Brassica oleracea* var. *capitata* L.) by *P. drechsleri* in South Africa (Thompson and Phillips, 1988).

A *Phytophthora* sp. was isolated from rotted roots of both 'Premier' kale (*Brassica oleracea* L. var. *acephala* DC.) and 'Tyfon' [*Brassica rapa* L. x *Brassica pekinensis* (Lour.) Rupr.]. Both winter forage crops were grown under furrow irrigation in a clay loam soil in northwestern Wyoming. Morphological characteristics, optimum temperature for mycelial growth and host pathogenicity were studied to determine species identity.

Wyoming isolates of *Phytophthora* from *Brassica* spp. were compared with each other, as well as with an Australian isolate of *P. megasperma* from *Brassica napus* var. *napus*, a Great Britain isolate of *P. megasperma* from *Brassica* sp., both obtained from D. C. Erwin, University of California, Riverside; a Wyoming isolate of *P. cryptogea* from sugar beet (Vincelli et al., 1990) obtained from W. F. Wilcox, Cornell University, Geneva; and a Wyoming isolate of *P. megasperma* f. sp. *medicaginis* from alfalfa (Gray et al., 1983).

Morphological Studies. Observations of fruiting structures in water cultures containing mycelial plugs and 3-5 day-old seedlings were made at 7-14 days and in solid and liquid media at 14 days. Cultures were maintained at 25C under a 12 hr light/12 hr dark cycle. The kale and Tyfon isolates of *Phytophthora* were similar morphologically. On corn meal agar, both exhibited considerable fluffy aerial growth. Hyphae were up to 8 µm wide. Hyphal swellings were rare in both corn meal and clarified V-8 juice agar, and in liquid 1/5 strength V-8 juice culture media. Hyphal swellings and sporangia of both isolates occurred frequently on mycelium attached to infected host plant seedlings when placed in water cultures. Most sporangia were non-papillate, however, older sporangia could be classified as having papilla, especially when they were close to germination. Bi-flagellate zoospores of the fungus were formed and released from sporangia. Sporangia appeared to be ovoid to obpyriform in shape. Sporangia measurements varied considerably; 27-44 x 41-62 µm with a mean of 35 x 52 µm for the kale isolate and 27-37 x 36-57 µm with a mean of 32 x 44 µm for the Tyfon isolate. These measurements were similar to those previously described for *P. megasperma* from cauliflower by Tompkins et al. (1936) in California. Sporangia usually were single, produced on a long thin sporangiophore and were non-caducous. No sporangia were observed on solid media. In the presence of host seedlings in water, extended internal proliferation of the sporangia was observed. Sometimes sympodial arrangement of sporangia was observed in water cultures, especially in the presence of secondary host (alfalfa) seedlings (Figure 1).

Oospores of kale and Tyfon isolates were abundant on corn meal agar and liquid V-8 juice culture media. Oogonia were spherical and oospore walls were smooth. Oospores of both isolates were produced readily in host tissue of seedlings in water cultures and to a lesser extent in mycelium attached to the seedlings. Oospores produced in the host tissue tended to be smaller than those produced in solid culture media. The minimum and maximum oogonia diameters for the kale isolate were 27 µm and 58.5 µm, respectively (mean of 48 µm). The minimum and maximum oogonia diameters for the Tyfon isolate were 46 µm and 62 µm, respectively (mean of 54 µm). Oogonia from these isolates were larger than those described for *P. megasperma* from cauliflower by Tompkins et al. (1936) in California, but were similar in size to those described by Hamm & Koepsell (1984) in Oregon from cabbage and cauliflower. Also Drechsler (1931), in his original description of *P. megasperma* indicated oogonia size as 47 µm.

Oospores of the Australian isolate were readily produced in solid corn meal agar culture media. Oogonia were spherical and oospore walls were smooth. Oospores were also produced in tissue of Tyfon seedlings placed in water culture containing mycellium plugs. The minimum and maximum oogonia diameter were 30.2 µm and 39.9 µm (mean of 34.4 µm).

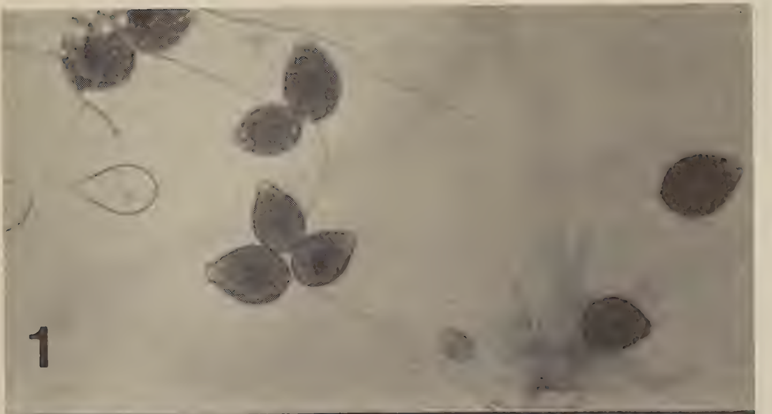
The Great Britain isolate did not produce oospores in either solid media or seedlings of Tyfon or Kale and was assumed to be heterothallic.

The *P. cryptogea* isolate from sugar beet produced small (27 x 38 µm) sporangia, rarely on solid media. However, when sugar beet seedlings were placed into petri dishes containing water and agar plugs of the fungus, irregular shaped sporangia were observed. No oospores were observed in liquid or solid media suggesting the possibility of heterothallism. Thompson and Phillips (1988) reported an isolate of *P. drechsleri* from cabbage to be heterothallic. On solid media, hyphal swellings of the fungus were abundant.

The alfalfa isolate formed oospores in tissue of alfalfa seedlings in water cultures and in corn meal and clarified V-8 juice agar media. Oogonia had a mean diameter of 31 µm and oospores had a mean diameter of 26 µm. Sporangia and hyphal swellings were readily formed on seedlings placed in water cultures.

Temperature Studies. All six isolates grown on corn meal agar were more tolerant of temperatures below 25°C than temperatures above 25°C. None of the isolates grew at 35°C. Only limited growth of isolates was observed at 5°C. Most of the time, kale and Tyfon isolates grew faster than the alfalfa isolate and generally, the growth rate of kale and Tyfon isolates were similar. Cardinal temperatures for growth of the kale and tyfon isolates were 0-5°C, 25°C, 30-35°C.

Optimum growth temperature for *P. megasperma* isolates from *Brassica* spp. was previously reported to be 25°C (Tompkins et al., 1936; Jones, 1952; Cvjetkovic et al., 1983). This temperature was also the optimum growth temperature for *P. megasperma*, in general (Waterhouse and Waterston, 1966). All of the four *Phytophthora* isolates from *Brassica* spp. included in this study also grew best at 25°C. Jones (1952) reported minimum temperature for growth of *P. megasperma* from *Brassica* spp. as slightly below 5°C which was in agreement with our study. Growth after 7 days at 25°C of isolates of *Phytophthora* spp. tested are shown in Figure 2.



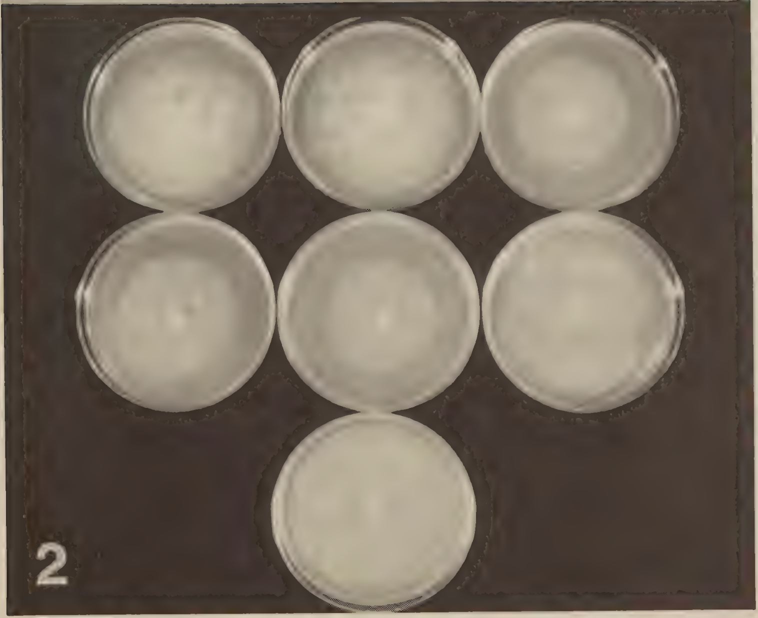


Figure 1) *P. megasperma* (kale isolate) showing sympodial arrangement of sporangia observed on alfalfa seedlings (100x). Figure 2) Isolates of *Phytophthora* spp. on corn meal agar (from left to right) top row: kale (*Phytophthora* sp.), Tyfon (*Phytophthora* sp.) and alfalfa (*P. megasperma* f. sp. *medicaginis*); second row: sainfoin, *Onobrychis viciifolia* Scop. (*P. megasperma* f. sp. *medicaginis*), *Brassica napus* var. *napus* (*P. megasperma*) (Australia), *Brassica* sp. (*P. megasperma*) (G. Britain) and *P. cryptogea* from sugar beet .

Radial growth rate of mycelium for the kale isolate was much faster than the alfalfa isolate in several substrates tested. After 7 days, mean growth rate for the kale and alfalfa isolates was 10.6 and 8.5 mm in CMA with dextrose, 11.2 and 6.0 mm in CMA without dextrose, 11.2 and 5.5 mm in clarified V-8 juice agar, and 9.1 and 4.3 mm in PDA.

Pathogenicity Tests. In growth chamber pathogenicity tests, the alfalfa isolate of *P. megasperma* f. sp. *medicaginis* was pathogenic to seedlings of 'Premier' kale, 'Tyfon', 'Emerald' rape as well as 'Ranger' alfalfa. However, it was more virulent to alfalfa. Average percent mortality for kale, rape, Tyfon and alfalfa after 21 days at 25C under a 12 hr light/12 hr dark cycle was 15, 24, 30 and 100, respectively when inoculated at seeding.

The *Phytophthora* isolates from kale and Tyfon were similarly pathogenic to seedlings of kale, rape, Tyfon and alfalfa with average percent mortalities of 83 and 53, 87 and 94, 68 and 64, and 61 and 58, respectively.

In the older (4-month-old) plant studies, the kale and Tyfon isolates induced root rot in both kale and Tyfon but not in alfalfa, while *P. megasperma* f. sp. *medicaginis* induced root rot only in alfalfa. Overall, the kale and Tyfon isolates had a wider host range, but were less pathogenic than the alfalfa isolate.

From our studies, it is concluded that isolates of *Phytophthora* sp. recovered from kale and Tyfon plants best fit the description of *Phytophthora megasperma* Drechs. (Hansen and Maxwell, 1991; Stamps, Waterhouse, Newhook and Hall, 1990). This is the first report from Wyoming of *P. megasperma* on kale and Tyfon and the first report of *P. megasperma* on Tyfon in North America.

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BOOK REVIEWS

D. S. Hibbett, Book Review Editor

Die Gattung *Hyphodontia* John Eriksson, by Ewald Langer. Bibliotheca Mycologica, Band 154, with 144 figures Softcover, 225 x 141 mm, 298 pp., 1994. J. Cramer, Gebrüder Borntraeger, D-14129 Berlin, D-70176-Stuttgart. ISBN 3-443-59055-1. DM 130.--.

Monographic treatments of basidiomycetes from the family Corticiaceae are indeed rare. There are only a few specialists in the world dealing with Corticiaceae taxonomy and generic delimitation is frequently a great obstacle. The genus *Hyphodontia* is one of the few groups of corticioids which are possible to recognize by traditional methods.

The book presented here covers the known species in the world. Together with *Hyphodontia*-like species in other genera, 60 species are treated. A comprehensive introduction contains details on micromorphology, a formal emendation of the genus *Hyphodontia* and keys to the species. Species descriptions make up most of the book and these are excellently worked out. Nomenclature and morphological descriptions are followed by line drawings of microscopic details and sections of basidiomata. Of particular value for the user are comments following each species description, where differences between closely related taxa and possible misdeterminations are presented.

One new species is described and five new combinations are made in *Hyphodontia*. The genera *Schizopora* and *Echinoporia* are treated together with species of *Hyphodontia*. There is no doubt about their close affinities. This has been convincingly shown by Langer and others in micromorphology of basidiomata, culture characters (presence of drepanocysts and malocysts), and parenthosome structure, which is of a continuous type. The main reason for not including them all in one genus is because of nomenclatural changes which would be inevitable, as *Schizopora* was described well before *Hyphodontia*. This situation is solved by retaining the genera *Schizopora* and *Echinoporia* for the few species treated there and which moreover are morphologically well distinguished from other hyphodontioid fungi. Seven species described in *Hyphodontia* or *Schizopora* during the last decades are excluded from these genera.

The book ends up with a cladistic analysis based on morphological characters. This is another feature of this publication which rarely is seen in taxonomic works with basidiomycetes. This is also something which is difficult to perform because of the high number of parallellisms in character evolution and the small number of available, informative characters. Langer tries to solve the situation by prescribing the transformation of character states for a great number of characters. Even if these operations make the analysis weak, the principal infrageneric division will probably survive. This is linked to the presence of tramal cystidia or hymenial cystidia. It also seems to be obvious that the different hymenophore configurations are examples of parallellism. DNA sequencing will hopefully be the way to offer more reliable phylogenetic estimates.

The book is written in German with no English summary, but except for this limitation, it will be of immense use for all as a determination guide and source of information in exploration of Corticiaceae mycota. *Nils Hallenberg, Department of Systematic Botany, University of Gothenburg, Sweden.*

Atlas of Clinical Fungi, by G. S. de Hoog and J. Guarro (eds.). Hardcover, 210 x 298 mm, 720 pp., 1995. Centraalbureau voor Schimmelcultures, P.O. Box 273, 3740 AG Baarn, The Netherlands. Fax: 31-2154-16142. E-mail: info@CBS.nl. ISBN 90-70351-26-9. Hfl. 130.-- (+ postage).

Atlas of Clinical Fungi edited by G. S. de Hoog and J. Guarro was written to illustrate the diversity of medically important fungi. To achieve this goal, the editors divided the book into two portions. Part one contains discussions on classification, clinical pathology, natural ecology, general techniques, and a brief review of the major pathogenic fungi. Part two is reserved for rare and unusual opportunistic pathogens of medical and veterinary interest. This portion of the book is richly illustrated with superb line drawings and beautiful scanning electron and light microscopy photomicrographs of the morphological features used to recognize the various taxa of interest.

Pythium insidiosum is an important oomycete pathogen primarily of veterinary interest that many mycologists consider to be a member of either the kingdom Chromista or Protoctista. The treatment of *P. insidiosum* as a fungus seems inappropriate. 16S and 18S rRNA gene sequences, as well as other data, indicate that *Pneumocystis carinii* should be classified among the early ascomycetes. The treatment of *P. carinii* as a zygomycete will cause confusion for the readers of the book. Additional confusion results from the classification of *Bipolaris australiensis, B. hawaiiensis,* and *B. spicifera* in the genus *Drechslera.*

The discussion included in the section Clinical Pathology presents several difficulties. There is no need to create the superfluous disease name mucoralomycosis. Most medical mycologists consider superficial, cutaneous, subcutaneous, systemic, and allergic as the principal clinical categories for fungal diseases based upon location rather than that stated on p. 17. Table 3 (p. 17) contains several errors regarding the histopathology of the mycoses. *Penicillium marneffei* is a classic dimorphic pathogen and it is not classifiable in the Onygenales (p. 22-23).

Zootropic fungi are described as "...requiring living tissue for growth, at least during a part of the life cycle..." on p. 27. The dimorphic fungi were given as examples. The dimorphic fungi do not need to pass through an animal in order to complete their life cycle. They can grow, reproduce, and survive without ever passing through living tissue.

The current concept of the term "dimorphic" used by medical mycologists is quite different than that expressed within this book. This reviewer is unaware of anyone who considers *Cryptococcus neoformans, Chrysosporium parvum,* or *Wangiella dermatitidis* as dimorphic fungi in the same sense as *Blastomyces dermatitidis, Coccidioides immitis, Histoplasma capsulatum, Paracoccidioides brasiliensis*, or *Penicillium marneffei* (p. 28, table 8). The clinical laboratory techniques described are useful, but incomplete in several areas. It is disappointing that the editors did not develop and then apply criteria for distinguishing acceptable from unacceptable case reports, especially for rare opportunistic pathogens. Unfortunately, many readers of their book will assume that the fungi included in the book associated with reported infections are actual confirmed etiologic agents of infection. In reality, many are not. For example, *Absidia coerulea* was cited as a pulmonary pathogen, yet the editors state that it cannot grow at human body temperature (p. 244). Overall, the book contains a superb collection of line drawings and photomicrographs that are not readily available. These illustrate the majority of fungi of medical and veterinary interest. The medical mycology portion of the text, however, contains numerous problems and egregious errors that diminish the importance of the book. *Michael R. McGinnis, Center for Tropical Diseases and Medical Mycology Research Center, Department of Pathology, University of Texas Medical Branch, Galveston, Texas.*

MacClade: Analysis of Phylogeny and Character Evolution (Version 3.0), by W. P. Maddison and D. R. Maddison. Softcover, 200 x 232 mm, 398 pp, 1992, and computer program version 3.05, 1995. Available in North and South America from Sinauer Associates, Sunderland, MA 01375-0407, U.S.A. Tel.: (413) 549-4300. E-mail: biology@sinauer.com. ISBN 0-87893-490-1. US$ 75.-- Program + book; $40 Book; $10 Chapters 3-6 on phylogeny. For orders from Europe or Africa, contact W. H. Freeman and Company Ltd., 20 Beaumont Street, Oxford OX1 2NQ, England.

"*MacClade is positively addictive and will give you a much better feel for the tree and your data. It's the closest thing to a phylogeny video game that I have seen.*" Joseph Felsenstein (**PHYLIP** main documentation).

MacClade is an interactive Macintosh computer program that lets you explore how characters evolve under alternative phylogenetic hypotheses. Using **MacClade**, you can draw a tree and then modify it, moving a taxon from one place to another with a quick movement of a mouse. The program uses parsimony to reconstruct character state changes for each tree you draw. **MacClade** is designed for rapid data entry. It accepts morphological and molecular characters of several kinds and it allows you to define how individual characters can evolve. Version 3.05 permits up to 10 continuous (non-integer) character states for each character. The data matrix format encourages precise definition of morphological characters and allows extensive annotations. In addition to text, the matrix can include scanned pictures of organisms, characters, or distribution maps. Comparing pictures is inconvenient, however, because the program only displays one picture at a time. As an alternative to writing a file in **MacClade**, you can import a data matrix written in one of several other formats or open a data matrix created with a text or sequence editor. One caution though: When saving a file created by another program, **MacClade** keeps only "perfect" NEXUS file format and erases any other comments and formatting.

Unlike programs or packages such as **PAUP**, **PHYLIP**, or **Hennig86**, **MacClade** is not designed to find all the most parsimonious trees for a data set. Instead, **MacClade** works cooperatively to analyze trees from other programs. **MacClade** has an extensive charting ability for comparing trees and character statistics and its clean graphical output appears regularly in publications and seminar slides. Constraint trees designed in **MacClade** can be used directly in **PAUP** or exported for use with **PHYLIP**.

The **MacClade** program package includes a 398 page book providing a clear explanation of phylogeny, parsimony and character evolution. We recommend the phylogeny section to our students as a coherent introduction to the field. The book also outlines program capabilities that surprise and delight us. For example, the program can perform "stratigraphic parsimony," estimating minimum ages of divergence from available fossil evidence.

The Maddisons maintain the **MacClade** Web Page (http://phylogeny.arizona.edu/macclade/macclade.html), which answers common questions and provides good suggestions. A free version 3.05 updater for those who have older versions of **MacClade** is available at the same site. A demonstration program of **MacClade** ver. 3.05 is available by gopher, FTP (fetch) or WWW at ftp.bio.indiana.edu. The three alternatives to **MacClade** are less powerful and less user friendly. **Clados** is a comparatively limited DOS based program. **PHYLIP**, by Joseph Felsenstein (http://evolution.genetics.washington.edu/phylip.html), is a suite of free programs and documentation for phylogenetic analysis that will work on most types of computers. The **PHYLIP** programs **MOVE**, **DOLMOVE**, and **DNAMOVE** incorporate some of the branch swapping found in **MacClade** and allow comparison of the costs of alternative hypotheses. The third method requires a pencil, a ruler, and lots of paper and erasers. Instead of blindly putting in characters and accepting computer output, **MacClade** lets you explore alternative phylogenies and their consequences. We strongly recommend the book and program, and they are well worth the price. *Mary Berbee, Department of Botany, University of British Columbia, Vancouver, B.C. V6T 1Z4, Canada, and David Carmean, Biological Sciences, Simon Fraser University, Burnaby, B.C. V5A 1S6, Canada.*

Mushrooms: Poisons and Panaceas, by Denis R. Benjamin. Softcover, 152 x 230 mm, 422 pp., 1995. W. H. Freeman and Company, 41 Madison Avenue, New York, NY 10010. Tel.: (212) 576-9400. Fax: (212) 689-2383. ISBN 0-7167-2649-1 (paperback) 0-7167-2600-9 (hardcover). US$ 34.95 (softcover) 59.95 (hardcover).

Human beings ingest mushrooms to cure illness, satisfy hunger, or achieve spiritual enlightenment. For the naive or uncautious, however, the results of mushroom consumption may include pain, terrifying visions (a "bad trip"), or death. Thus, it is of little wonder that mushrooms and mycophagy both fascinate and frighten people of many cultures. In this far-ranging volume, Denis Benjamin seeks to document the history and practice of mycophagy world-wide, as well as describe the diverse mechanisms of mushroom poisoning, and their treatment. The author, a physician, is particularly qualified to advise on the latter topic.

The book is divided into three major parts: 1) Mushrooms and Health (100 pp.); 2) Mushroom Poisoning (71 pp.); and, 3) Mushroom Poisoning Syndromes (173 pp.). The first part includes the ethnomycological and historical material, as well as sections on health and nutritional aspects of mushrooms. The chapters "Cultural Attitudes Toward Mushrooms" and "History of Mushroom Eating and Mushroom Poisoning" include numerous references to historical texts, with liberal use of quotations. This section provides insight into the origin of contemporary attitudes about mushrooms and includes some of the most enjoyable passages in the book. Although all cultures are surveyed, the treatment here is decidedly eurocentric, which is understandable considering the language barrier. Nevertheless, the medicinal use of mushrooms in China, and the approximately 1400-year history of their cultivation, deserved a better treatment. The second part concerns the distribution and occurrence of toxic mushrooms and the sociology of mushroom poisoning. Also included here is the chapter, "Diagnosis and Management of Mushroom Poisoning," which presents a condensed overview of symptoms, prognosis, and treatment for the various types of mushroom poisoning syndromes. This valuable chapter has been printed on shaded pages for quick reference. The third, and largest, part of the book treats each of the major mushroom poisoning syndromes. For each, the responsible fungi and their seasonal and spatial distributions are discussed, along with critical reviews of what is known about the mechanisms of toxicity. Specific recommendations for treatment expand on the material in the chapter on "Diagnosis and Management." These chapters synthesize a large body of primary source literature; there are 137 references for the chapter on "Amatoxin Syndrome" alone. This book includes numerous anecdotal accounts of mushroom poisoning, many from the author's own journal. These add a human perspective and make the book more readable, but some clinicians may find them superfluous. Lastly, there are four appendices, which include an amusing juxtaposition of chemical formulas for fungal toxins with a bibliography of mushroom cookbooks.

This book will provide a useful resource for amateur and professional mycologists, toxicologists, emergency room staff, and others. The emphasis is clearly on mushroom poisoning, but the other materials add interest and provide a cultural context for understanding mycophagy. *D.S.H.*

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